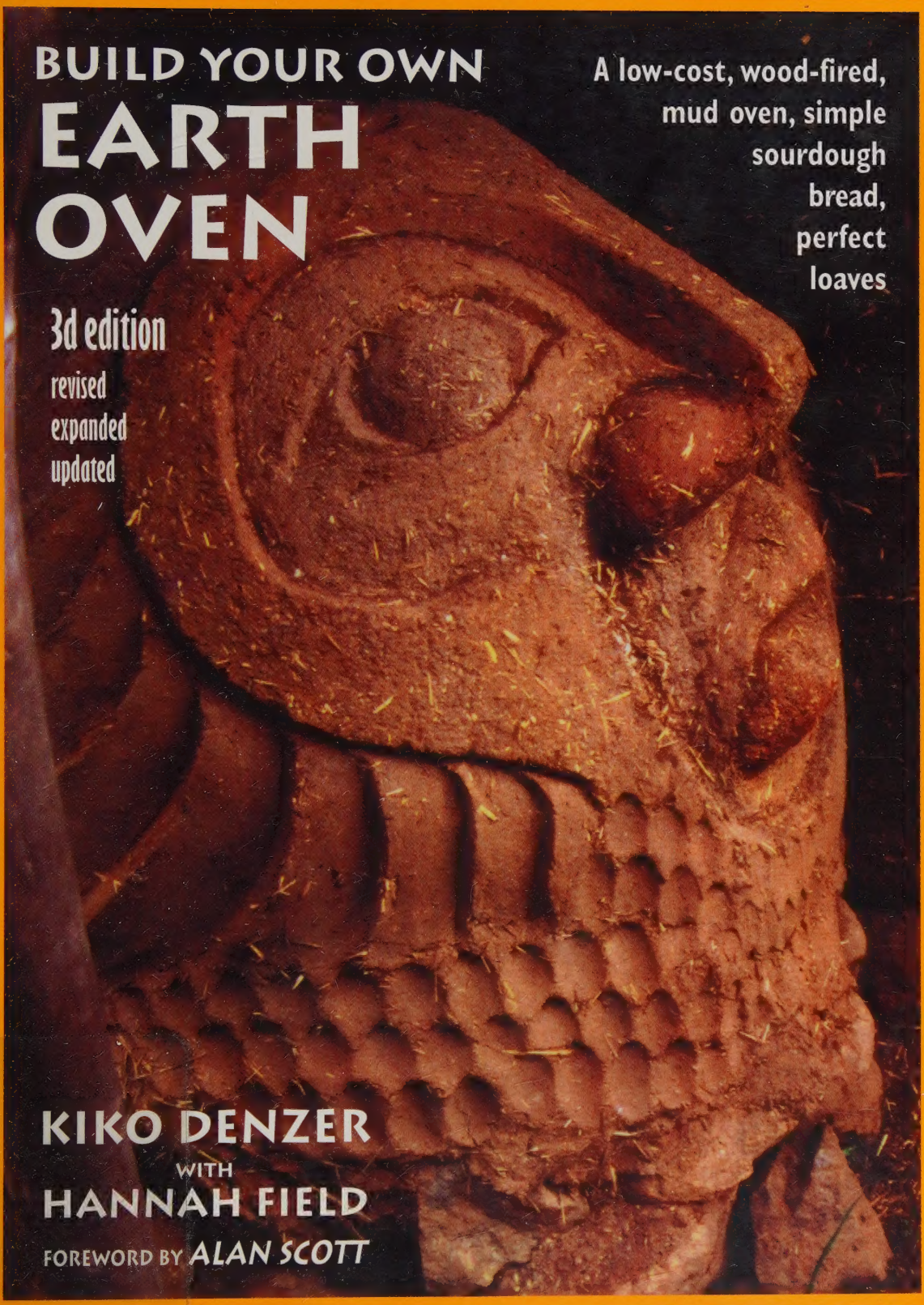
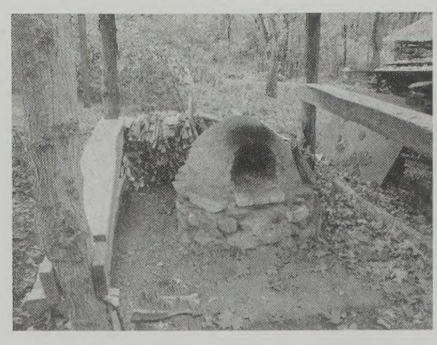
BUILD YOUR OWN EARTH OVEN

A low-cost, wood-fired, mud oven, simple sourdough bread, perfect loaves

3d edition
revised
expanded
updated



KIKO DENZER
WITH
HANNAH FIELD
FOREWORD BY ALAN SCOTT



A PLAIN WORK OVEN

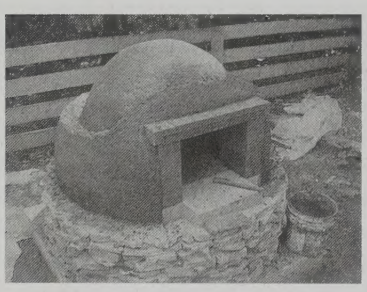
"A group of friends came over and we created the oven body in a day. It fires well, but the interior is a bit small, and we enlarged the door to handle our stew pots. Our family bakes 4 loaves of sourdough bread each weekend; before and after, we bake stew made of leftovers, a bit of venison, and garden vegtables. The base is local rock; the sand for the cement and the oven mix came out of the foundation hole."

— Sam Droege, Maryland

FRIENDS, FIRE & DREAMS

"It was a community effort really, that included our Olympia Waldorf School 3d grade and other friends. The oven went up in 2 sessions separated by a week in between. The roof structure actually took a lot longer and was by far the most expensive part of the project. Actually, the cedar shingles were the only expense at roughly $60. We bake about once a week and often have guests young and old who want to participate in the process. In many ways this hearth has added a warm glow to the heart of our home. It's wonderful to have this fire presence activating friends and dreams."

— Warren Cohen, Olympia, WA



ORDER OF THE OVEN

"…Your book set off a cascade of events in my life, starting with the gathering of materials, planning and replanning, daubing mud and plaster and baking bread and pizzas. Now I'm a disciple of the Order of The Wood-Fired Oven. Friends and family scatter when they see me, because they know that's all that I want to talk about!"

— Ron Henderson, OR

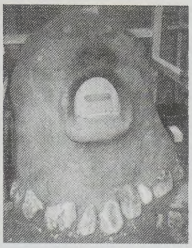
SQUEALS OF DELIGHT

"…The oven has become a focal point when friends come to visit…I fire it up and let the bread rise, and we sit in the shade of a nearby tree so we can smell it baking. We've learned to savor the process…

….I built it outside of a miniature village in my backyard. My whole family joined in…The village has five buildings, and while my grandkids enjoy them, they never felt much kinship…because I did it for them (even though they helped…). But mixing the cob while getting deliriously muddy, and hearing squeals of delight while stomping in some more...it's a sound that touches the soul…."

— Greg Jones, Eugene, OR

MUD ADVENTURE



"Have finally put he finishing touches on the oven.... We were planning to bake this weekend but the weather has deterred us.... thank you again for...sharing of your knowledge. A friend of mine was so enthusiastic that he asked me to build an oven for/with him. So the summer is looking good with more mud adventures. I'm working on a peel at the moment and hoping that the weather will change soon."

— Christo Markham, The Netherlands

2.5 WEEKENDS

"Bought your book a month ago and just finished plastering. It took me 2.5 weekends but I had to get materials and pour the slab it's sitting on. Thanks for your wonderfully thoughtful and inspiring book!."

— Todd Deangelis

REFERENCE FOR LIVING

"Your Earth Oven book has been more than just a project guide for my wife and I, it truly is a "how to" reference for living, especially in this crazy fast paced world that we constantly find ourselves up against here in Seattle. I think I've read through it three times now. We also recently purchased your new "Dirt Art" book, and are equally excited about using and learning from it. As my wife is getting her teaching certificate for art education she is using some of the concepts you share as she develops her description of her teaching philosophy for class. Keep doing what you're doing... Thanks a bunch."

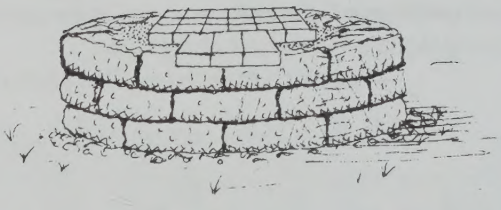
— Brooks Stanfield, WA

KIDS MOST HELPFUL

"I met Kiko and Hannah at a workshop where they they built a small earthoven in a couple of hours. I was amazed at how easy it was. So when I came home, I built a foundation and got some buckets of mud. I had 3 kids round for the weekend and anybody who has had kids milling around like there is no tomorrow, knows that 4 channels on TV is not enough.... Just as things got out of hand, I produced the mud and found that the kids were most helpful."

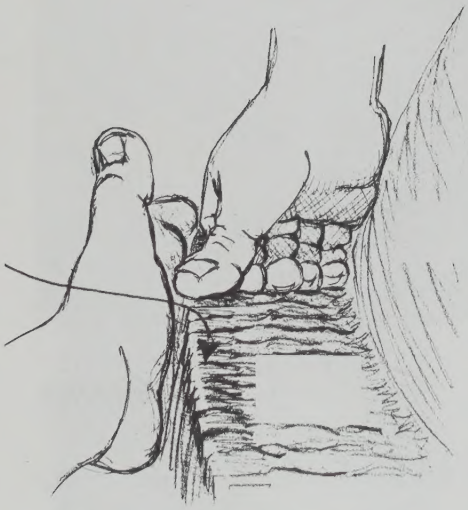
— Knut Caspari, Norway

DIG DIRT!

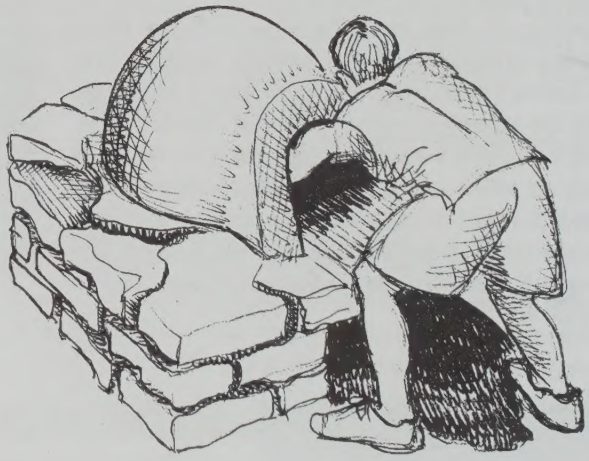


LAY A FOUNDATION

1. DIG DIRT, MAKE A BASE

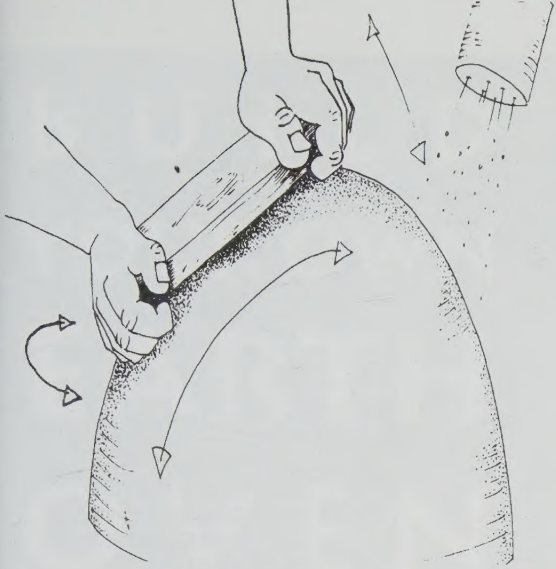


BUILD UP LAYERS



REMOVE SAND

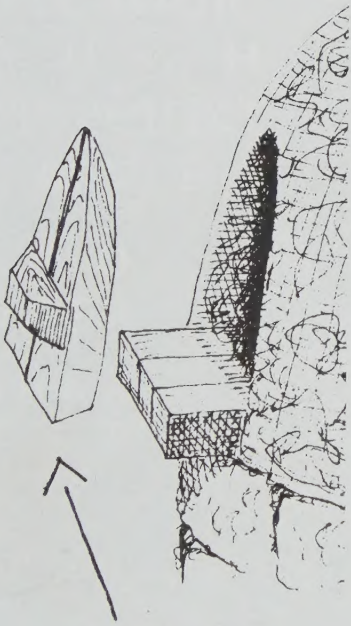
3. MAKE AN OVEN



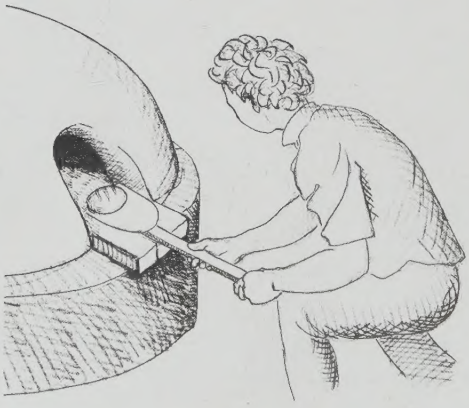
MAKE A SAND FORM

MIX MUD

2. MOLD SAND, MIX MUD



MAKE A DOOR



GREAT BREAD!

4. DRY IT OUT, BAKE BREAD!

ALSO BY KIKO DENZER:

Dig Your Hands in the Dirt: A Manual for Making Art out of Earth

Make a Simple Sundial

Earth Art, A Catalog

FOR ISAAC & EBEN

Talking is teaching.
Listening is learning.
Education is sharing.
Experience is a seed,
and even the bitterest seed will grow.
Culture is the fruit of common experience —
a common responsibility, and
our common wealth.
If work is love made visible,
then love is everywhere you look.

Build Your Own Earth Oven
A Low-Cost, Wood-Fired Mud Oven, Simple Sourdough Bread, Perfect Loaves,
Third edition, copyright 2007 by Kiko Denzer; all rights reserved; please contact the publisher for permissions.
Hand Print Press
Post Office Box 576
Blodgett, OR, 97326, USA
541-438-4300
www.handprintpress.com

Illustrations and photos by the author, except as noted; drawings on pages 25, 54, 74, 79, courtesy of Ann Wiseman and Ansayre Press. "Sourdough Haiku" on page 87 courtesy of the author.

Printed in the U.S.A.
10 9 8 7 6 5 4 3 2

Publisher's Cataloging-in-Publication Data
Denzer, Kiko;
with Hannah Field.
Build Your Own Earth Oven: A Low-Cost, Wood-Fired Mud Oven,Simple Sourdough Bread, Perfect Loaves / Kiko Denzer, with Hannah Field.
3d ed., 132p. : ill; 25 cm.
Library of Congress Card Catalogue Number: 2006910453.
ISBN 978-0-9679846-7-4
1. Stoves
2. Earth Construction
3. Cookery (Bread)
4. Bread
TX 657.S9 d46 2007
641.58 Denzer

BUILD YOUR OWN EARTH OVEN

A LOW - COST, WOOD-FIRED, MUD OVEN, SIMPLE SOUR-DOUGH BREAD, PERFECT LOAVES

KIKO DENZER
WITH
HANNAH FIELD

CONTENTS

Foreword, by Alan Scott i

Seven Arguments for Mud 1

Preface(s) 3

Introduction
- The Bread Cycle 6
- Why a wood-fired, earthen oven? 7
- Earthen Building, or what is "cob," anyway? 10
- How to Catch Heat 12
- Dig Your Hands in the Dirt 13
- Experiments: Three holes in the ground 14
- A Simple Design, A Better Oven 18

Chapter One: Site Prep, Design, Materials, & Tools
- Location 21
- Oven size: twice the loaves in half the space 22
- Roofing & other options 23
- Beauty, sculpture, art; Building soil, mud, masonry, clay 24
- Finding & Testing Clay soil 25
- Prep: Materials, tools, quantities, lists 29

Chapter Two: Steps to an Oven
- Step One: foundation 39
- Step Two: insulate your floor 41
- Step Three: make your hearth floor 44
- Step Four: consider a door 45
- Step Five: make a sand form, or shape the void 50
- Step Six: first layer: dense "oven mud" for thermal mass 52
- Step Seven: open the doorway 57
- Step Eight: layer two — insulation 57

Chapter Three: Structural Cob & other Sculpture
- Good shape 59
- Recipe: traditional "cob" or sculptural/structural mud 60
- Finish mud, or plaster 61
- Lime plaster & other water-resistant, breatheable plasters 64

Chapter Four: Using Your Oven
- 1. "Oven wood" is the best fuel 67
- 2. Dry your fuel 67
- 3. Use small sticks 68

4. Live Fire needs to breathe - give it air 68
5. Improve combustion with a firing door 68
6. Learn to estimate temperatures 69
7. Soak your baking door 69
8. Remove the remains of the fire 69
9. Clean the oven floor 70
10. "Soak" your oven 70
11. Test for Baking temperature 70
12. Load your loaves 70
13. Adjust time and temperature to suit your baking needs 71
14. Pizza & live fire cooking 71
Assemble a set of traditional baking tools 72

Chapter Five: Simple Sourdough Bread

Artisan bread & Introduction 75
Hannah's four steps to good bread, and principles to make them work for you 76

Chapter Six: Principles for Burning

The Metaphysics of Fire 89
Efficiency 90
How heat works in Masonry 91
Making the most of masonry 93
On Chimneys 94
Other Principles 96

Chapter Seven: Oven Variations

Mobile ovens 98
Community ovens 101
2-Chamber oven 102
All clay ovens (Canadian too) 103
Tandoor ovens, kilns for pottery and other uses 104
Brick Ovens & Ovens for the world? 105
A low-mass, high-efficiency "rocket oven" 106
Hi-Mass, hi-efficiency "rocket" Heater for the home 107
Experimental "rocket" oven 107

Chapter Eight: Troubleshooting & Follow-up

Use 109
Construction 111
Design 113

Afterword

Earth, ovens, art 117

Resources

Books on bread, building, food & culture; plus weblinks & contact info 122

Index

..... 125

FOREWARD

Ovens and bread exemplify how simple connections to land and food, through simple and appropriate technologies, can heal many ills. The publication, in 1984, of the Laurel's Kitchen Bread Book brought to light the virtues of using whole grain flours in bread baking and for the first time published a recipe, or rather a process, for baking naturally yeasted breads. These breads required a wood-fired, brick or earthen oven and helped to spawn the "sourdough" revolution.

Kiko's book brings basic information about such ovens (and a basic approach to good whole grain bread) back to the home, so families can be empowered to bake their own healthy bread. Making one's own bread is an essential break from the industrialized model that manufactures our basic foods for us – and for all the wrong reasons. We have been surreptitiously colonized, but here is one small way to evolve beyond this grip.

It has always been my opinion that it is better to instigate such alternatives here in our own culture before running off to change the world — the third world in particular — for it is we who have been saturated with materialism and now feel a dire need for a new direction in spiritual and personal growth. The rest of the world is watching and can learn from us if we lead.

Education is the path and good books are the instructions to follow when all else fails. Keeping in mind life after industrialization, Kiko's book is exemplary and holds one of the keys to this vital non-violent social change.

— Alan Scott, Oatlands, Tasmania, 2007

7 ARGUMENTS FOR MUD

Below: Il Convento San Giorgio, in Italy's mountainous Abruzzo, is being revived as a center for culture and environment. Hendrik offered his services to the convent, and they asked him to build this beautiful oven. He was introduced to ovens when "someone invited me to an oven workshop for a weekend…your book…was the guide which our tutor used…." *Oven & photo courtesy of the builder*

1. MUD IS FUN.

Your kids can help you build an earth oven. *This is very important.* Do they know more about computers than they do about the earth that feeds them? With mud between their toes (and dough between their fingers), they can learn how it feels to be a plant, with roots that can taste the fertile soil, and leaves that eat sunlight!

2. MUD IS FAST.

I've built 12" diameter demo ovens in 15 minutes, and full-size ovens in half a day.

3. MUD IS ART.

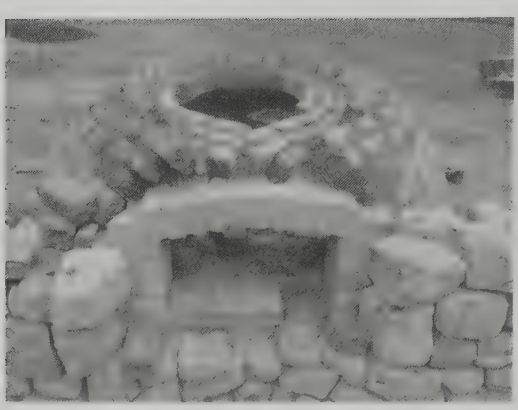
The simple, round shape of the oven is plenty art, but you don't need to stop there.

4. MUD IS CHEAP.

A scrounger can make a mud oven for free. If that's not you, you need not spend more than $100. Start small: a 21" diameter oven will bake several loaves, small pizzas, chickens, etc. and requires little wood and shorter firing times. My biggest mud oven is 4x4 foot inside; 9 foot diameter outside (see color section). Others have built bigger.

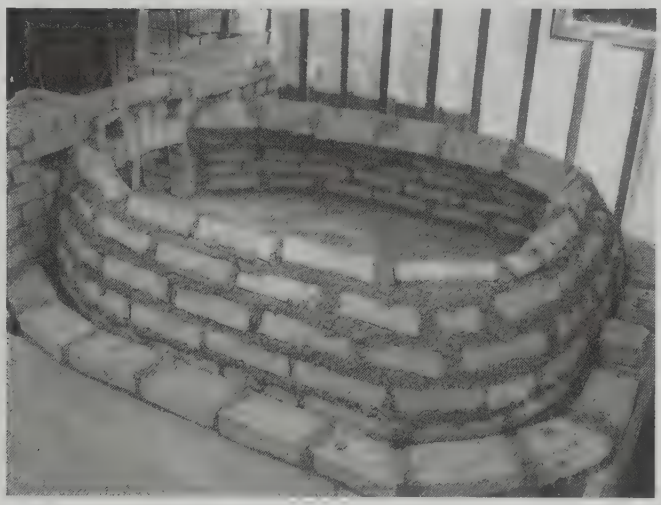
5. MUD IS COMMUNITY.

Shared ovens have long been the heart of communities. That still seems to be true in some families, neighborhoods, co-housing groups, parks, or when a new restaurant opens. Some come "if you build it;" others may want to jump in, get dirty, and build it with you!



6. MUD IS ADAPTABLE.

You can make a fast-firing, thin-walled pizza oven, a big oven for a home business, a small camp oven, a sculpted outdoor kitchen with seating, and more. You can build right on the ground, on sawhorses, or on a permanent foundation of stone, brick, or cob (earth).



7. MUD *IS* BRICK.

Fire turns mud to brick (quality varies with soil, clay content, your mix, etc.). The ovens at left are modern specimens of an old tradition of German "backofens" made of special mudbricks that include manure and sugar! The two layer design features an insulation gap between the first brick shell and the second (the first course of the second shell is visible at bottom). *Holger Laerad, photos.*

Sol Neelman, photo

PREFACE TO THE THIRD EDITION

For thousands of years, ovens have been modified, adapted, specialized and re-invented for many purposes. This book has only been around for ten years, but after 20,000 copies (translation into Norwegian!), many workshops, and feedback from near and far, I need to update my teaching text! First, I've revised and re-organized all the information so it's easier to use and understand, and developed a simple, super-insulated design that will hold heat longer and cook more food with less fuel burnt.

Second, my wife Hannah (whom I met when this book was just a pamphlet), has greatly improved our bread — and the bread chapter. She's simplified real sourdough to just four steps that you can adapt to your own schedule. Meanwhile, we've started milling the grain we bake (and hope one day to grow). A few bread-hungry neighbors trade us for foods we don't raise, and that adds leavening to our community.

Third, a brief mention of mobile ovens in the last edition generated a disproportionate number of inquiries. Chapter seven offers a variety of options and examples. I'm also posting more info at handprintpress.com (including notes on trailer design by Dan Wing, co-author of *The Bread Builders,* and owner/builder of a well-traveled mobile oven.)

Fourth, feedback from builders in Africa, Indonesia, and South America has raised questions of fuel shortages and deforestation. While I haven't tried to address those issues, it is true that a masonry oven requires heating up not just bread dough, but a whole heavy oven, too. While you can be efficient with a masonry oven (either with daily use, or by using all the residual heat as the oven cools), other wood-fired designs use less wood to cook more bread. What's most appropriate? I don't have an easy answer, but have tried to address the issues as best I understand them in chapters six & seven, and to offer more resources.

Last and most, *the* most gratifying feedback I've gotten has been from readers who have rediscovered in the dirt something essential, useful, and beautiful. I've included many of their wonderful stories and ovens. And am grateful!

If the hearth is the heart of the home, ovens extend that out into the community. But an oven is *still* just a hole in the ground; and a house is merely a bigger hole with a smaller fire. Build one, and you can build the other.

— *Kiko Denzer, 2007*

IF YOUR MUD MAKES SNAKES, IT WILL MAKE AN OVEN, TOO
Bob Carlson, photo

PREFACE TO THE SECOND EDITION

Mud — earth, clay, soil, dirt, the stuff under your feet — is a near perfect building material. Thousands of years ago, the first oven was made of mud. People all over the world still bake in earthen ovens, and the best ovens in the fanciest bakeries are typically made of brick — which, after all, is just kiln-fired mud.

If you're a beginner, remember: even if you've never built a thing, your hands will show you how if you'll just start. We are all born into the tradition of building and making — it's how we learn to tie shoes, cook eggs, swing a hammer, drive a car, and even how to play video games or surf the web (technology still begins, and usually ends, with our hands).

Building a mud oven isn't complicated. Pay more attention to what you're doing than to what I've written. Common sense and experience will be your best teachers. If you're uncomfortable or feeling doubtful, go slow. Take a break if you don't know what to do next. Solutions will come, and they will come easiest if you aren't in a hurry.

Granted, a good oven alone doesn't make good bread, which is why this book includes an introduction to real sourdough bread. But a mud oven (with help from the baker) can produce perfect bread — equal or superior to the fanciest $5 loaf. I once took ten loaves of mud-baked bread to a wedding party for a German friend — five sourdough rye, and five sourdough wheat. All his German family and friends said, "this is just like home!" and asked where they could buy it. Some of them begged for a loaf to sustain them as they travelled in a land not known for its bread. I later made a

pizza oven for a local summer festival. My wife Hannah was head baker and a caterer friend provided dough and toppings; they made and sold about 250 pizzas per day, each one cooked to perfection in two to three minutes. People raved.

A mud oven is also a good place to make mistakes: under-cooked lumps, and burnt crusts. But under-cooked dough can lead to grand discoveries: I sliced, toasted, and crushed up some under-cooked bread once because I was loathe to throw away good (almost) raw material. I put the granules in jars on my shelves. One breadless morning, I decided to try soaking the stuff in milk with a little sugar — and heard echoes of Euell Gibbons praising the flavor of "wild hickory nuts." Now I always keep some on hand, even when I don't under-cook the bread. As for burning bread, I have learned that "burnt" is a matter of opinion. In some European countries, crusts that others might consider burnt are prized for the more intense flavor of the caramelized crust. And while charred is charred the world over, you can always cut away the burnt bits. Once, as an experiment (and because it was ready to bake and still rising fast), Hannah cooked a loaf in a 700 degree pizza oven. In less than ten minutes, the bread came out black, but we pared off the crust, and found it perfect inside. And of course, sometimes when you bake in a mud oven, you get sandy grit in your crusts. Materials vary, and while most of them work, some work better than others. When I get sandy bread, I just trim the crusts, bake in pans or on paper, or build a better oven.

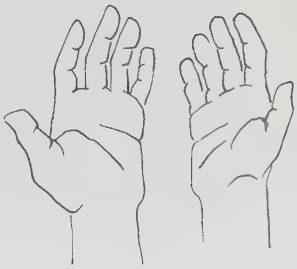
Making things means making the most of your mistakes. There are also, of course, risks and responsibilities. Oven fires are well-contained, and pretty safe, but you can't be too careful! Watch your fire, but also build so that an un-watched fire can't spread to timber, grasslands, buildings, etc. Where I live, there's no fire department, and I don't have fire insurance. I have to be careful, and have tried to convey prudence and caution in what I write. However, you may want to check your plans against local fire and/or building codes and make sure that what and how you build won't compromise your insurance policies. For more comprehensive technical or safety information, you could start with titles in the Resources section.

Good building and baking to you! Please do let me know if you have questions or suggestions (or photos!) that might help to improve a future edition.

— Kiko Denzer, 2001

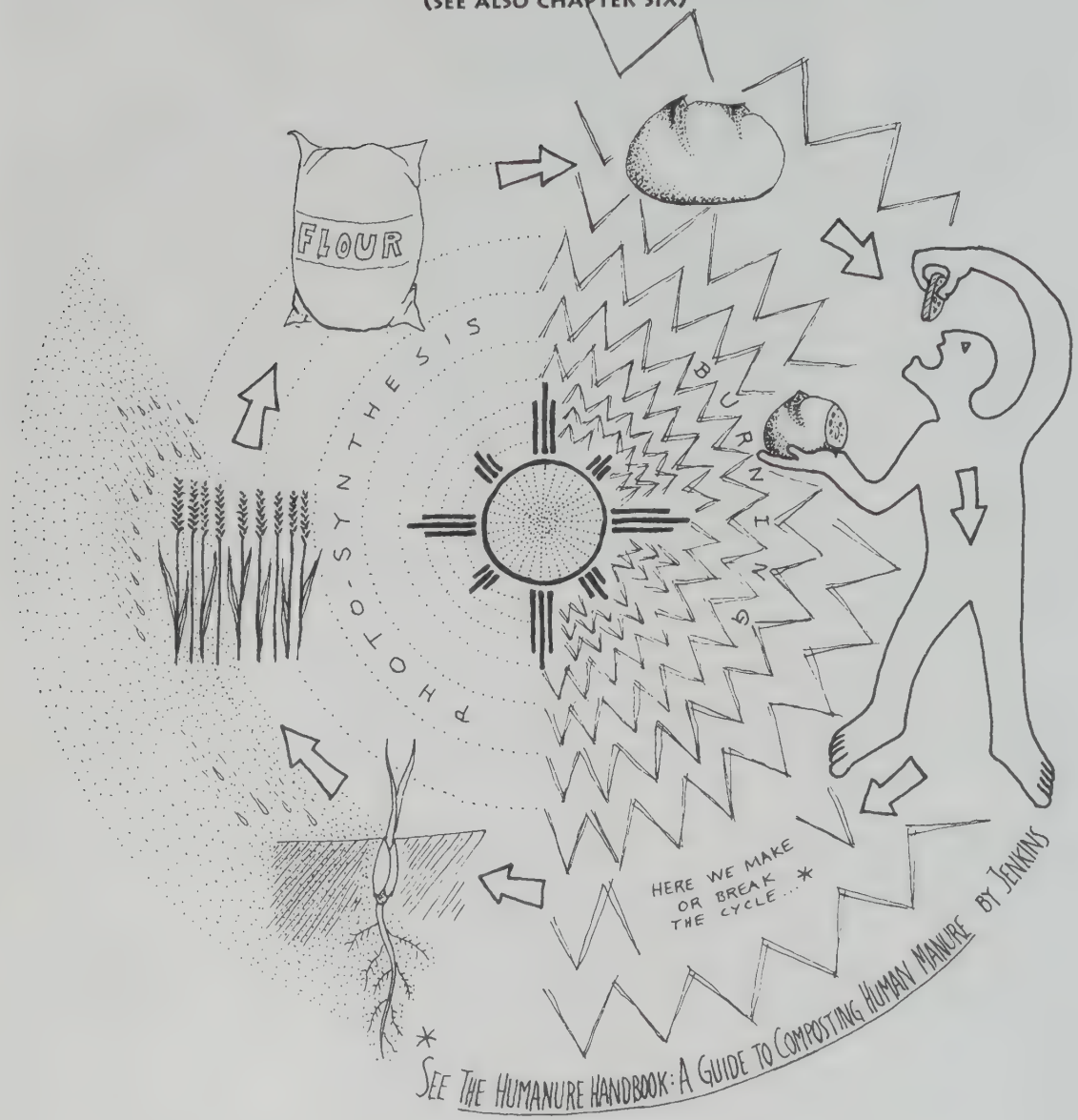
TIPS, OPTIONS, SCROUNGING OPPORTUNITIES, & OTHER RESOURCES

Marginal notes like this one offer tips for making do, limiting expense, trying a different material or technique, and learning more. They also highlight recommended books and other useful information. (For a full list, see the Resources section.)



The Bread Cycle

FROM PHOTOSYNTHESIS TO BURNING AND BACK
(SEE ALSO CHAPTER SIX)



A BREAD STORY:

Five things alone are necessary to the sustenance and comfort of the 'dark ones' [Indians] among the children of earth: The sun, who is the Father of all. The earth, who is the Mother of men. The water, who is the Grandfather. The fire, who is the Grandmother. Our brothers and sisters the Corn, and seeds of growing things.... Who among men and the creatures could live without the Sun Father? for his light brings day, warms and gladdens the Earth Mother with rain which flows forth in the water we drink and that causes the flesh of the Earth Mother to yield abundantly seeds, while these, — are they not cooked by the brand of fire which warms us in winter?

— from *Zuñi Breadstuff*, by Frank Hamilton Cushing, 1920

INTRODUCTION

WHY A WOOD-FIRED, EARTHEN OVEN?

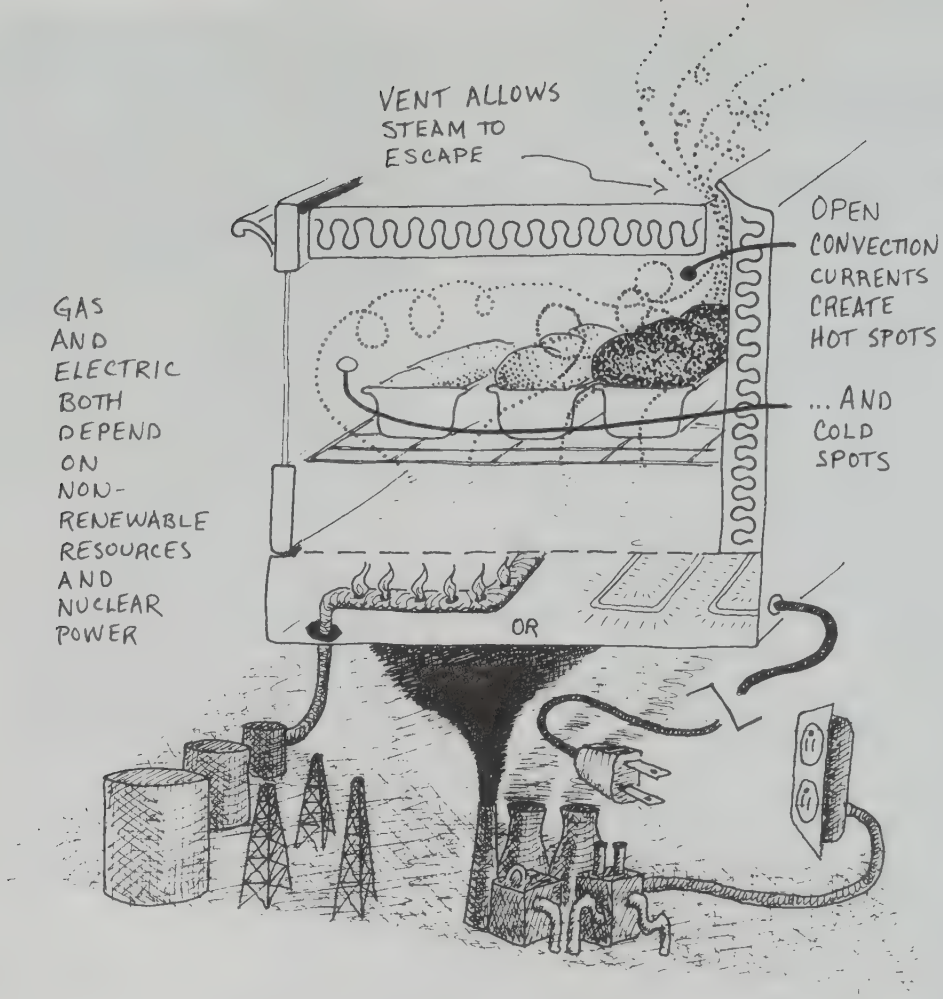
Let's start with bread — real, naturally leavened, sourdough bread. Many books make it seem mysterious and difficult — which it isn't. However, like any living thing, and most real food, real bread differs according to circumstance. So the secret to good bread is like the secret to good dancing: know your partner, and practice! Bread, however, and cooking, involve more than two partners: you have the ingredients, the cook, the tools, the oven, the eaters.... Our kitchens sometimes get in the way: we turn on the radio/TV/ipod; we're in a hurry to get the meal done before the next activity, the mail is on the counter, the dog is at the door, the phone is ringing, etc. Or it just seems easier to buy the damn bread.

Building and baking in a wood-fired earthen oven restores beauty, savor, and real bread by restoring the essentials: earth, water, air, and fire. And it requires you to participate. In most modern kitchens, you don't have to feel the heat, watch the fire, or grow the ingredients. Similarly, bread machines and commercial yeast require little or no attention. They take care of themselves. But if you don't have to pay attention, you can't participate, and if you don't participate, you can't know.

What happens when you make bread in a wood-fired oven? Plants transform the energy of the sun into fiber, food, or fuel; fire transforms fuel into energy; water dissolves and lubricates stony soil, creating the clay that you model into a massive oven; the oven absorbs and holds the energy of the sun released by burning wood. After a couple of hours, the oven is so hot you can remove what's left of the fire and bake the dough you made from sun-ripened seeds, living sourdough culture, and water. The hot, dense earth radiates heat at a steady rate (like the sun!) so you can cook not just bread, but also beans, meat, potatoes, soup, vegetables, pies, cakes, cookies, scald milk for yogurt, and finally, dry out the wood for your next fire. The Zuñi story at left says essentially the same thing, but poetically. The drawing says it visually. This book is a way to do it.

AN OVEN STORY FROM COLORADO: *[W]e spent three good days chopping straw and making mud, and now we are enjoying our oven so much...We have had to experiment with the timing...is the oven ready? is the dough ready?, etc....but we are getting there! ...My grandmother, a Sicilian immigrant, built her own brick oven wherever she lived. I was fortunate enough to be old enough to help her with the baking during the late 30s.... (Did you know that there are still the remains of the Roman earthen ovens in the ruins of Pompeii? We saw them a few years ago...and I was amazed.)*

— Lennie Kakalecik, photo & story.



Back to bread and ovens: Radiant heat *does* seem to make better bread. Why? When you bake, you transfer energy, through fire and oven, from wood to dough. How you transfer that energy makes a difference. There are three options: radiation, convection, and conduction.

Heat is energy ("it's a verb, not a noun.") Most fundamentally, it, *radiates* its energy via electrons, which are present everywhere — radiant transfer allows heat to travel even through the emptiness of deep space. *Conduction,* on the other hand, requires direct contact between molecules of solid materials (think of an egg on a hot frying pan). *Convection* is what happens when heated liquid or gas expands. Expansion makes it lighter than its surroundings, so it "floats" (thus it isn't "heat" that rises, it's heated water or air).

The conventional oven in your kitchen heats the air and that's what heats and cooks your bread. Even with no hot or cold spots, baking more than two loaves in such ovens requires arranging them so every loaf is heated equally. So-called "convection" ovens try to improve the situation with a

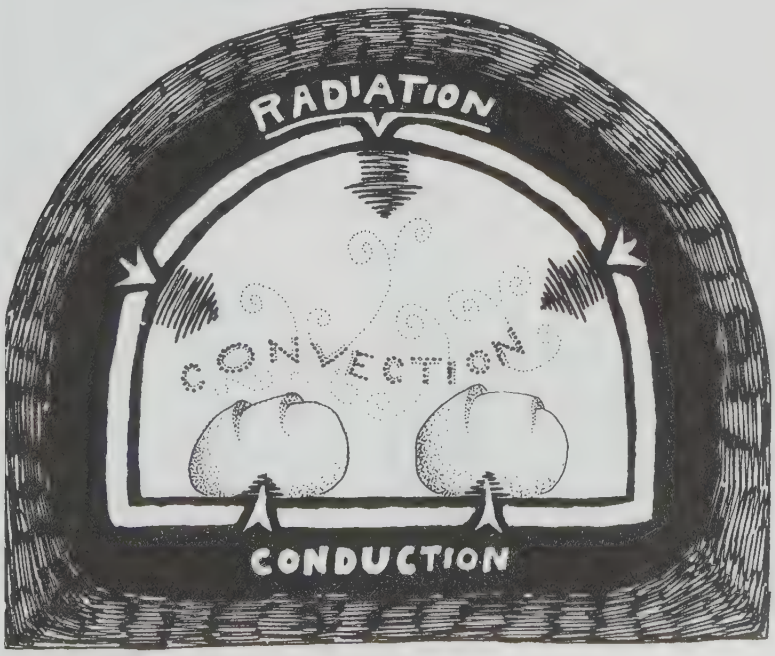
fan that hurries the hot air around, but that often dries the bread as well as cooking it. Baking stones help, but they are substitutes.

An earthen oven bakes your bread using all three kinds of heat transfer: *radiant* heat from the hot walls; hot bricks *conducting* heat directly into the bottom of the loaf, and hot, steamy air *convected* throughout. With all this heat from every direction, many loaves cook as easily as one.

ANNE'S LIZARD OVEN, WALES, UK
Anne Belgrave, photo

In addition, the different kinds of heat working together improve "oven spring" — the irregular air holes and high loaf that occur when a vigorous batch of yeasty dough gives a final surge of activity in response to all that heat. In addition, the superhot steam caramelizes the sugars in the outside layer of dough, producing a lovely, substantial, and flavorful crust.

Radiant heat is fundamental to our very existence — from it we have sun and seasons, photosynthesis and weather, food and shelter, and of course, wheat and bread. The architect Christopher Alexander says that humans have a biological preference for radiant heat — his answer to why people prefer an open fireplace to an open heating vent. Perhaps that's another reason why bread is better baked in a wood-fired oven....



EARTHEN OVENS MAKE GOOD BREAD BECAUSE THEY MOVE HEAT *THREE* WAYS:

1. *Radiant* heat, from hot, massive walls
2. *Conducted* heat, from direct contact with a hot brick floor
3. *Convected* heat, from hot, moving (& steam-charged) air.

EARTHEN INSPIRATION

The Hand-Sculpted House, by Evans, Smith, and Smiley, is a complete guide to building with earth, from siting and foundations, to walls, roofs, floors and finishes, as well as the larger context of how our homes impact our relationship to nature and each other. *Spectacular Vernacular*, by Carolee Pelos and Jean-Louis Bourgeois is an inspiring collection of photos and essays documenting the earthen tradition as practiced in Africa.

EARTHEN BUILDING, OR: WHAT IS "COB" ANYWAY?

Mixed with sand, water, and straw, a clayey-subsoil will dry into a very hard and durable material; indeed, it was the first, natural "concrete." In the Americas, we call it "adobe," which is originally from the Arabic, "al-toba," meaning "the brick." Invading Moors brought the word to Spain from North Africa, where an ancient mud building tradition continues today.

I learned about earthen building in the British tradition, where the same basic material is called "cob," from an old English word meaning "lump." The Brits skipped the step of forming bricks, and made their walls by packing wet blobs of mud on top of each other, letting them dry, and carving them smooth. Five-hundred-year-old cob houses are still common in Devon, England, where they are listed on historic registers, and highly valued.

Protected by roof and foundation from direct rain and snow, cob holds up very well, even in damp, windy Devon. I built a cob house in the temperate rainforest of the Oregon coast range, and it is much warmer and drier than my wooden cabin — not to mention safer from fire, and less vulnerable to bug damage.

But whether you call it "earth," "cob," "clay," or "adobe," it's all mud, and the oven you make will be very much like thousands of other ovens — some of which were probably built by your ancestors, because mud ovens are indigenous around the world. As you get to know your own local materials, you'll surely come up with your own improvisations and improvements, and the terms to go with them. So the earth claims us.

TRADITIONAL COB

Devon, England. Many hundreds of such houses date back centuries. My wife's aunt and uncle live in one that is recorded as having been a priest's 'hovel' 700 years ago. Note the carved corner on the closest building, and traditional thatched roofs.

MUD MAN OVEN & COTTAGE, OREGON, 1995

Ovens (and bakers) are best sheltered under a deep eave like this, or a freestanding roof. More roofing options are covered on pp 22-23, and in photos throughout. Ovens can also be built indoors with standard chimneys (and safety measures). The cottage here is located in Oregon's temperate rain forest and remains in excellent condition after more than ten years of exposure with no exterior "finish." Built by Ianto Evans, Michael Smith, and Linda Smiley, it has helped to revive a widespread interest in earthen building in North America.

At right: the oven door is under the fish chimney.

BAKING "BATTI" IN HOT COALS & ASH
Lillian Chou, photo.

HOW TO CATCH HEAT

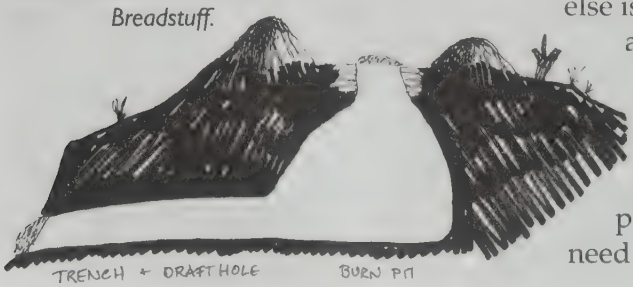
The purpose of an oven is to capture and hold the heat of a fire to cook your dough. Methods for doing this haven't changed at all over the millenia, and all the techniques are still in use today.

In India (photo at left), *batti*, made of wheat dough, are cooked on a fire fueled by dried cow dung: simple and immediate. On the opposite page, top, women in Tunisia bake on an unglazed clay "griddle" over a typical three-rock fire, perhaps the most common cooking "appliance" on the planet. Note the quantity of bread, and the fuel located between the rocks so the baker can adjust the fire as needed. Below that, a Moroccan baker cooks flatbreads on a "kanoor," a metal container lined with earth. Her griddle is the clay lid of a cookpot called a "tagine;" but she'll also cook breads on the oven's inside surface, a design and use similar to a classic "tandoor" (see page 104). Either way, the applicance is simply a container for holding heat, like your Kenmore range.

Perhaps the first oven was simply a hole in the ground big enough to cook a feast. In the southwest as little as a century ago, the Zuñi dug such holes in hillsides, filled them with fire, and when hot, re-filled them with corn that still wasn't ripe by the end of harvest time. Green stalks were added, the openings plugged (sometimes they blew out), and the whole tribe feasted. Leftovers were dried and stored; the event took days.

The oven in this book is not much different: an earthen "hole" on a brick floor; a simple door wide enough for fuel and food, but small enough to keep heat in, and high enough for air and smoke to flow in and out for good combustion. (All else is simply modification of shape; or added insulation, chimney, ash slot, or separate burn chamber.) A fire in the hole provides heat. When it's hot enough to bake, you sweep it clean, and cook. Some foods, like 2-minute pizza, roast vegetables, or steak may need an added small fire at the side or rear.

Below: an underground corn roasting oven, ancestor to the "horno," and big enough so people could get in to load and unload the corn. The upper opening was rock lined for stability. The two small mounds are probably leftover dirt. After a drawing in *Zuñi Breadstuff.*



DIG YOUR HANDS IN THE DIRT

Naomi Duguid/ ASIA ACCESS photos, from Flatbreads and Flavors, *by Duguid & Alford.*

Making one small, quick oven could give you far more confidence than several books, so I'm recommending a small practice oven or three to learn about materials and techniques. A few hours of experience will give you a much better grasp, not only of the building process, but also of how to make the best use of both your materials, and your oven.

So, read as much as you need, but do get started! I know of at least a couple of ten year olds who built ovens with little more than imagination and an idea.

One was a neighbor girl who read about an oven made by packing earth around an old wooden barrel which was then burned out (drawings and text on the next page). Since there

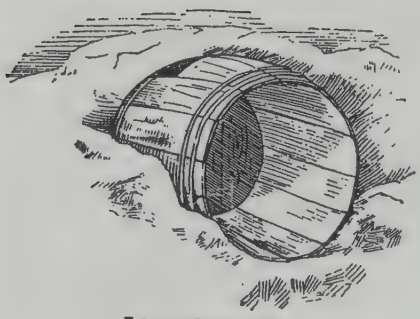


Fig. 111.—Barrel in Bank.

Fig. 112.—Heating the Oven.

weren't any old whiskey barrels around her house, she used a cardboard milk carton and made a beautiful mini-oven.

The second was a story I read on the web by a former Cockney kid from London. Between the wars, he (or she?) recalled how the family (along with "most of London") went to the Kent Hop gardens to pick hops, "earn a few bob for Christmas," and give the kids a rare fresh air holiday. They slept in huts and cooked on paraffin stoves or out in the open. Store bought bread was a long walk away, so this ten year old built mom an oven out of an old tin drum covered with the clay-soil of Kent — and gained many friends on Sundays, when everyone wanted to cook their roast.

So the only real requirements are inspiration and desire. The rest of this book is just the details of one version of a human tradition that we all belong to, and that begins with the cultivation of grain, some ten thousand years ago. Here we go:

"[A] bake-oven can be made of clay and an old barrel.... [M]ake a good, rousing fire in the barrel,...until all the staves are burned out and the surrounding clay is baked hard. This makes an oven that will bake as well, if not better, than any new patented stove or range at home..... If...you have no barrel..., there are other methods that will answer for all the cooking necessary to a party of boys camping out."

– D.C. Beard, in *The American Boy's Handy Book.*

Milan Chuckovich, bottom photos.

EXPERIMENTS: 3 HOLES IN THE GROUND

FIRST: A MUFFIN OVEN

You'll need a pile of sand a bit bigger than your oven, bricks for the hearth floor, and building soil (not your best garden soil, but the tough, sticky clayey stuff below. How to identify building soil is covered more thoroughly later, along with other technical matters, but for now, see how much you can do just by feel).

Assemble a rectangle of three or four bricks on a flat spot. Wet some sand, and make a nice firm, hemispherical mound of sand all the way to the edges of the bricks (some of the bricks will stick out where you'll cut the door). The sand mound should be a bit higher than it is wide. Drape it with a layer of wet newspaper.

Mix 3 or 4 parts sand and one part of your building soil. Mix thoroughly with enough water to make a firm dough. Add building soil if it seems too sandy, and vice versa. Pack a 2 inch layer of this dough solidly around sand and bricks until you have a larger version of your original mound.

For a door, draw a nice arch on the front, about 2/3 as high as the oven, and nearly as wide as the brick floor. Cut it out with a knife or spoon. Remove the sand (the newspaper will indicate when you've gone far enough).

Build a fire in your oven to dry it out. Use very fine kindling, or dry twigs. It should burn merrily, but if it chokes and smokes and seems to want more air, move fire and sticks around, take some out, and generally play with it. If that doesn't fix things, cut your door higher.

After it's totally dry, you should be able to heat it up to (at least muffin) baking temps in about an hour or so (since it's so small, you'll have to tend the fire to keep it burning well). When you're ready to bake, clean out all the fire, coals, and ashes, put in your cookies, and cover the opening with a piece of wood or what-have-you. Don't be too disappointed if it doesn't hold heat for very long. At this scale, the opening size can significantly diminish the ability of the oven to hold heat.

Now you should know a lot about how your mud feels and behaves: how does it combine with sand? How does it shape and pack? How hard does it get when dry? How well does your sand make a form? How do your bricks hold up to fire? Were you able to get a fire burning in the back of the oven? How did you clean out the hot coals and ashes? How long did it take for the masonry to get hot?

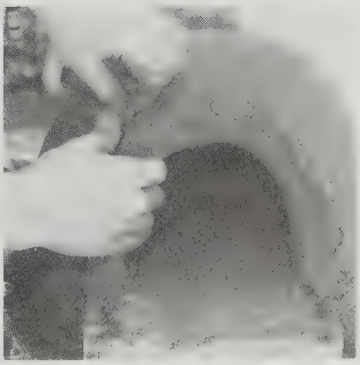
Are you ready to try it on a larger scale, and see if you can't get a loaf of bread out of it, too!?

MAKING MINI-OVENS:
You can make them on a single brick, or more (at this scale, a high door is needed for a good fire). Tom Rizzo's kids made 5 tiny ovens, He passed on his favorite comment, from his wife, "who decided to do this...sort of on a lark. She supports the idea of building a mud oven, but really it was my idea. Well, she called and told me what she and the kids were doing and she said, 'It was FUN!! I had no idea it would be this much fun! All of the kids are just giggling.'"
Tom Rizzo, top photo

SECOND EXPERIMENT: A 1- OR 2-LOAF OVEN

You'll need a bit more mud, sand, and bricks. For a 22 inch diameter oven, allow about three 5-gallon buckets of sand for the form, and about four buckets of mud-sand mix for the oven itself. And enough bricks to make a square floor (or "hearth").

If you want it up off the ground, make a ring of rock, cinder block, or even logs or cordwood. The ring should be about 3-1/2 feet in diameter, at least a foot high, and solid enough to contain a filling of tamped rubble, rocks, gravel, and sand. When it's good and solid, level it off smooth with sand so your bricks will set firm and flat.



A SMALL, ONE-DAY OVEN: This is about a 22-1/2" oval oven: just big enough for small pizza! The base is firebrick on concrete pavers on 2x planking on sawhorses (hasn't burnt through yet!) I thought it would be very temporary, but twice a year for more than 5 years, my folks have fired it up to feed guests at their semi-annual "meadowfest" and craft fair; in the winter, it's covered with a tarp.

The main difference between this oven and the one before is that now you're working at a scale where it pays to take some measurements.

- Your sand form should be 12-16 inches high.
- Door width should be about half the hearth diameter (10-12 inches).
- Door height should be 63% of the height of your sand form (7.5 - 10 inches).
- The mud layer should be 3-4 inches thick (no thin spots!)

In addition, for baking a loaf of bread directly on the brick hearth, you'll want tools to remove the fire, clean the hearth, and load the loaves into the oven. You'll also want a door to hold heat and steam in the oven while you're baking (if you make it before you make the oven, you can pack the mud right over it, for a perfect fit).

You may find that it takes a few firings before you get good baking results (residual moisture will keep it from reaching proper temperatures). But after you've baked in it for a while, you may start wishing it would hold heat a bit longer. Which leads us to:

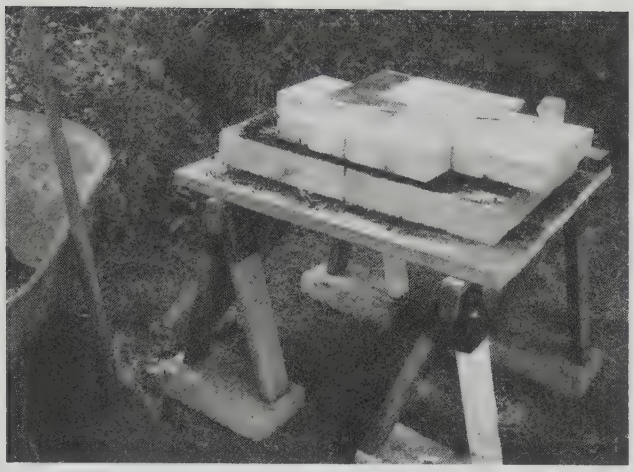
THIRD EXPERIMENT: A LAYER OF INSULATION

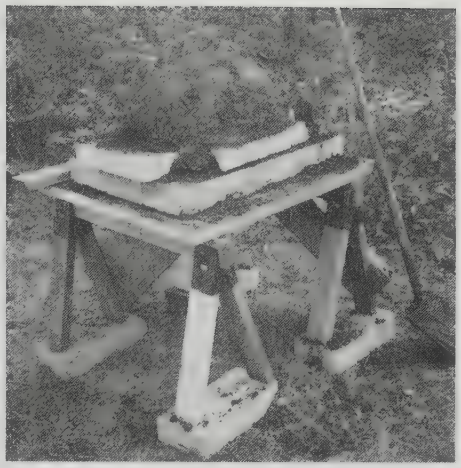
This one doesn't require you to start from scratch. In fact, all you need to do is add two (or three) more layers to your existing oven.

The first layer is insulation, to hold in the heat. The second layer is a finish plaster, to protect the insulation, provide a smooth surface, and perhaps to decorate. The third layer is sculptural embellishment, to taste.

My favorite insulation is coarse sawdust — usually free for the taking, or cheap, and easy to use. Mixed with a paint-like mixture of your clay subsoil and water, it will become a workable dough, and will also be heat and fire proof.

Mix clay and water until it's a smooth (non-lumpy) liquid





The shape is longer than wide, because that's all we could do with the bricks we had. Without readily available sand, I used soft Minnesota topsoil for the form, and then made the oven itself of pure subsoil, which was a nice mix of clay and silt that cracked a bit on drying, but not so much as to be problematic. I fired it dry the day after I built it, and we baked right away!

only as much slip as needed for stiff dough. Pack it around your oven in a layer 2-4 inches thick (you'll need 3-6 buckets full, or 15 gallons).

To finish, make another couple of buckets of mud-sand mix, but wetter, and add some fiber — finely chopped straw (or manure from grass fed herbivores: cows/horses etc.). The shorter the fiber, the smoother your oven. Smoosh it over the insulation layer. All tools are good: palms, fingers, flat boards, a metal spatula or masonry trowel, a kitchen knife or spoon. Play!

This oven may satisfy all your needs, especially if you mostly want pizzas and/or just a loaf or two, or need the oven just for special occasions, or for an experience of building with earth. On the other hand, you might want a better oven if:

- you find yourself doing lots of pizza parties and need to be able to make bigger pies than you can fit in the door,
- you want to bake bigger birds or roasts,
- you've started to appreciate the way the slowly declining heat lends itself to pots of beans and stews and desserts, and you want to get more of those kind of dishes out of a single firing, or
- you simply want to bake more loaves/food more often than your little oven will sustain (and you're starting to think about a small business...), or
- you've just been waiting for the book to get to this point in the first place!

A SIMPLE DESIGN, A BETTER OVEN

This last design can equal a professional brick or pre-cast oven in performance, and can be adapted for commercial use.

Two design aspects are primary: one is the level of the hearth, which is at a good working height for the baker — waist high, or roughly 40 inches. The other is insulation: this oven is fully insulated, under the hearth and over the top. This insures that all the heat is retained where you want it for as long as possible, rather than being drawn out through the floor of the oven into the cold ground.

There are foundation options to suit every budget and every timeline — each has its plusses and minuses. Sub-floor insulation is a bit trickier than insulating the dome, as it has to support the weight of hearth bricks and the structure of the oven itself. Neither aspect, however, requires more skill than does a basic oven — just a bit more time for design, planning, and material decisions and, perhaps, a bit more care in the actual construction.

All of this will be covered in full later on, but for now, we'll assume you've built your foundation and made your insulated base. The rest of the oven is the same as oven number three! There are refinements worth considering (especially a brick doorway, chimney, and ash slot), but these won't substantially alter the basic process or result.

Once completed and fully dried out, you'll find that the oven gets hotter faster, and holds heat *way* longer than an oven with an uninsulated floor.

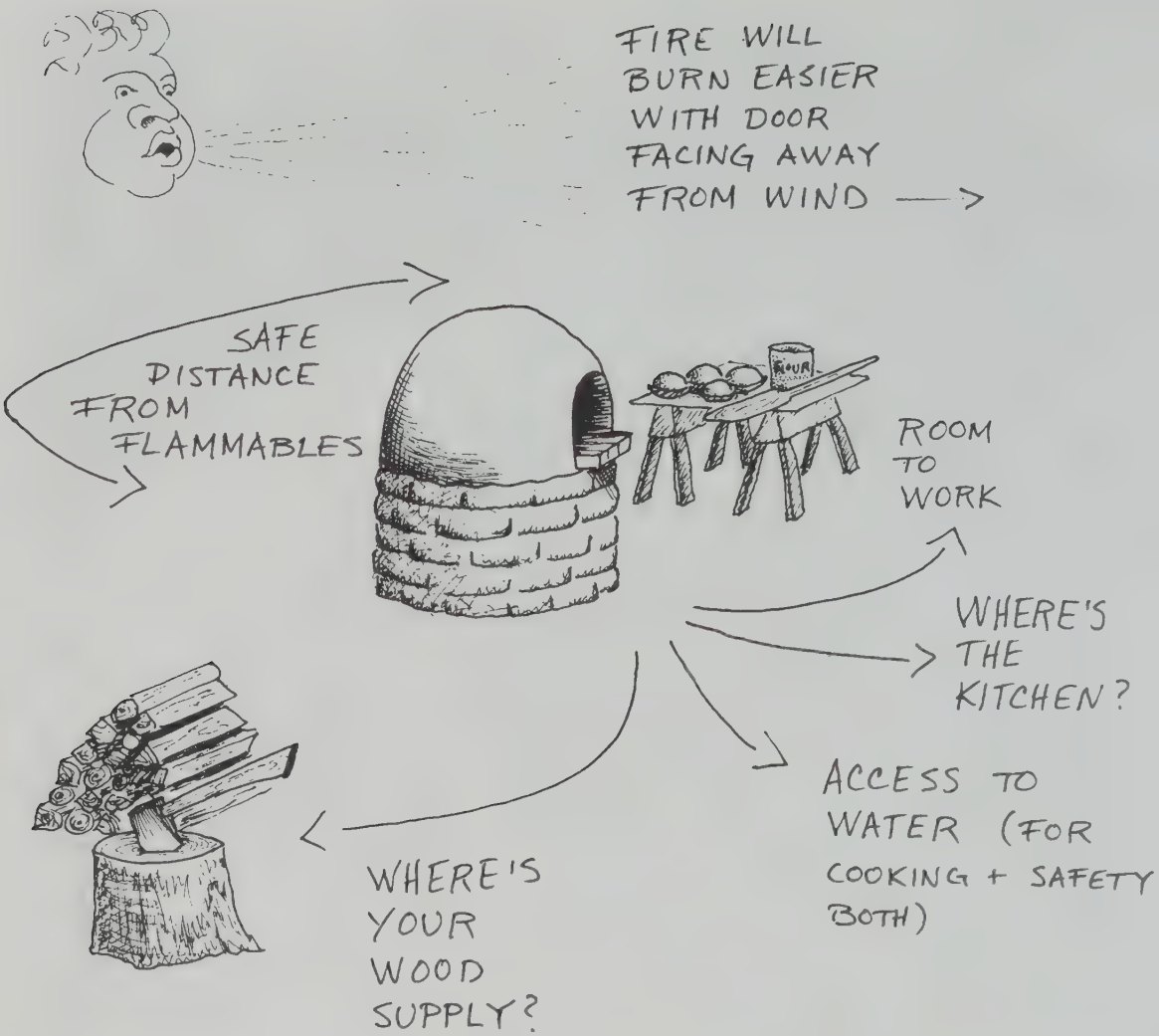
The rest of this book details the steps for building this super-insulated model.. If you want the simpler model, you can skip the subfloor insulation, but read that section before you decide. It's harder to draw on paper than it is to do. And once it's done, the rest is simple. Your main choice is whether to do it all at once, or in pieces.

CONSTRUCTION & DESIGN DETAILS

The base is a single ring of urbanite faced with the lovely round river rock. Above that are cylindrical walls of cob, filled with rubble and what-had-we. Ideally, I'd have extended the shed roof (and the work shelf) out to cover the baker, too, but such a roof would have blocked traffic through an essential driveway. So we make do by improvising a work table with boards and sawhorses.

OUR HOME OVEN

The hearth floor is 23x32 inches, big enough to bake eight or nine loaves at a pound and a half each. It has 6 inches of insulation all around, and holds enough heat to easily bake 15 loaves (about 23 pounds of dough) in two batches, as well as roasting vegetables or meats, baking pies, cakes, cookies; slow-cooking beans, soups, or stews, not to mention overnight rice pudding and scalding a gallon of milk for yogurt. Next morning, it is still over 200°F — perfect for drying wood for the next firing. The bits of brick in the doorway support the firing door. At left, note the stack of firewood on the bucket — enough for one firing (or a bit more)! The building is made of earth, too.... *(M. Chuckovich, photo, right)*



LOCATING YOUR OVEN

Might it be the center of a beautiful (cob?) enclosure? If a living sod roof is too ambitious, consider a garden wall to embrace the oven and the eaters.... (see photo, p. 95)

CHAPTER ONE: SITE PREP, DESIGN, MATERIALS, & TOOLS

AN OVEN IS AN OUTDOOR KITCHEN
Think how best to make it work for you: Especially for pizza, it helps to have easy flow from prep to oven. *Maria Denzer, photo*

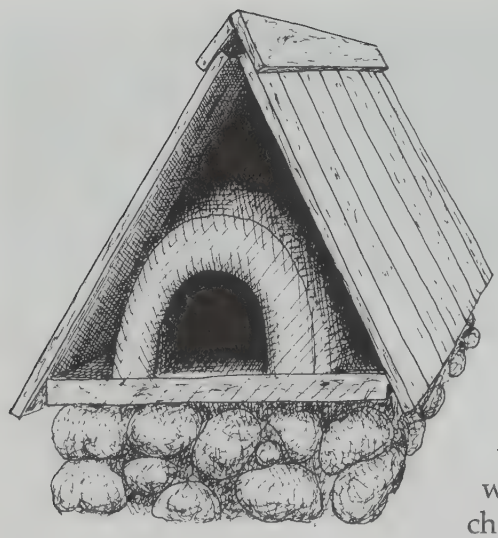
So you've gotten your hands dirty, learned a lot, and now it's time to build a permanent oven of a size that suits you, and also one that will hold heat as long as possible so you can make the most of the fuel you burn.

As with all indigenous building methods, the emphasis here is on the satisfaction of making something beautiful and useful with what you have on hand. Why "source" a list of standardized materials, all manufactured and sold (at your cost) for narrowly defined purposes that might not match yours, when you can dig up the earth under your feet, and look around home and yard (or your neighbor's, or the dump or dumpsters) to see what might serve? Especially when it comes to foundations, a little bit of innovation can save lots of work and/or expense.

LOCATION

Where your oven lives can make a big difference in how well it works for you. Answer the following questions first:

- Is it convenient to where you'll be doing the work of preparing your bread and other foods?
- Is it roughly level, or will the foundation require extensive digging?
- Is it in a place where you'll be able to use the oven when it's cold, dark, or rainy?
- Are there any good spots already protected by a roof or overhang?
- Which way does the wind blow? Will smoke cause problems for you or neighbors? Will it require a chimney? (You can also wait & see, and add a chimney later.)
- How will the oven itself affect its surroundings? Will a big mass be overwhelming? Can you design it to "fit"?
- What are the fire hazards and safety issues?
- Is it convenient to where you store your fire wood? Might your wood shed (safely) serve as oven shed, or vice-versa?
- Will your plans need to be approved for compliance with the building code, or to protect against possibly voiding fire insurance?



OVEN SIZE: FIT TWICE THE LOAVES IN HALF THE SPACE

A 22.5" oven gives you more than 2.5 square feet of cooking floor. But since you can easily bake two batches of bread with one firing, in effect, you get more than 5 square feet: twice the loaves in half the space.

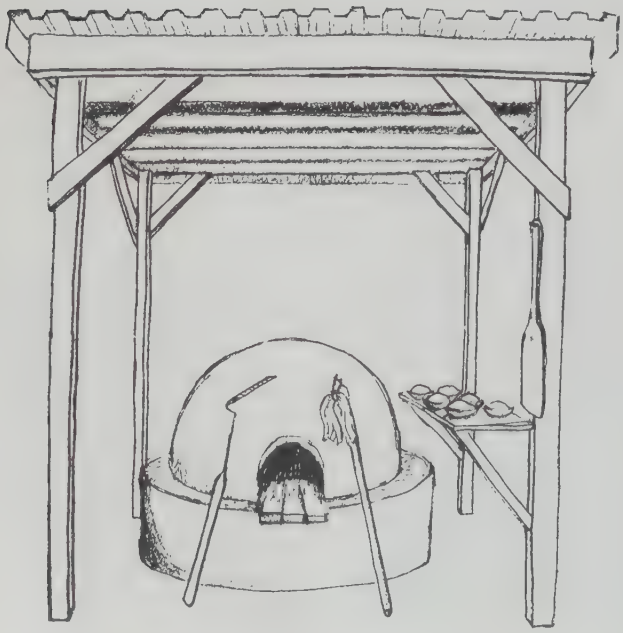
You can build bigger, of course, but that means more time and materials, not to mention wood to chop and longer firing time. For those who do need a larger oven, however, the materials chart on page 30 specifies amounts for three sizes. The rest of the process is basically the same, no matter the size (unless you get really big, which is partially addressed on page 114). Keep in mind, too, that a 48" oven is restaurant sized: enough to make *lots* of pizza, as well as other dishes, and a few hundred loaves of bread a week (though it's probably not big enough for a full scale bread operation).

A fully insulated oven can cook for up to 12 hours or more (this will vary with the oven, but see photos & caption on p. 18-19 for an example). To determine the size you need, ask yourself if you intend to bake daily, weekly, monthly, or twice a summer? Just breads? Or meat too? Your favorite roasting trays or stew pots may dictate size. You can also lay out loaf pans, baking trays, or rounds of paper as big as you make your loaves, and see how big a circle (or oval) you need to contain it all. (Remember that hearth loaves rise and/or spread, and that a wider door (to accommodate cookie sheets or large pizzas, for example) may necessitate adjusting the shape of the oven to make it deeper or wider.) And if your "ideal" size seems huge, remember that you can bake in batches.

If you build bigger or smaller than specified here, use the illustrations to sketch out your own plans — even rough drawings will help you visualize the work ahead (especially if you're trying any innovations or experiments).

TWO ROOFING OPTIONS

Above: a Canadian-style oven with a traditional A-frame roof; **below:** a simple shed roof on poles with room for a bread shelf and tools



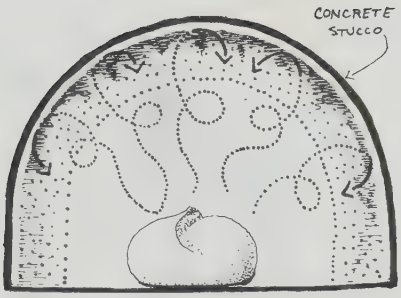
ROOFING AND OTHER OPTIONS

Please don't "waterproof" your oven! Like any living thing, an earth oven needs to breathe. When baking, it "exhales" steam (a pound of bread steams off a couple ounces of water). A waterproof finish (cement or paint), traps moisture in the oven. If it meets a non-breathable finish, it will condense and soak back into the oven, softening it, or causing collapse.

Most impermeable finishes also crack, allowing water in faster than it can get back out. If the mud gets soft enough, it will leak out with the water. Or the water freezes, cracks grow, the finish peels off, the oven erodes.

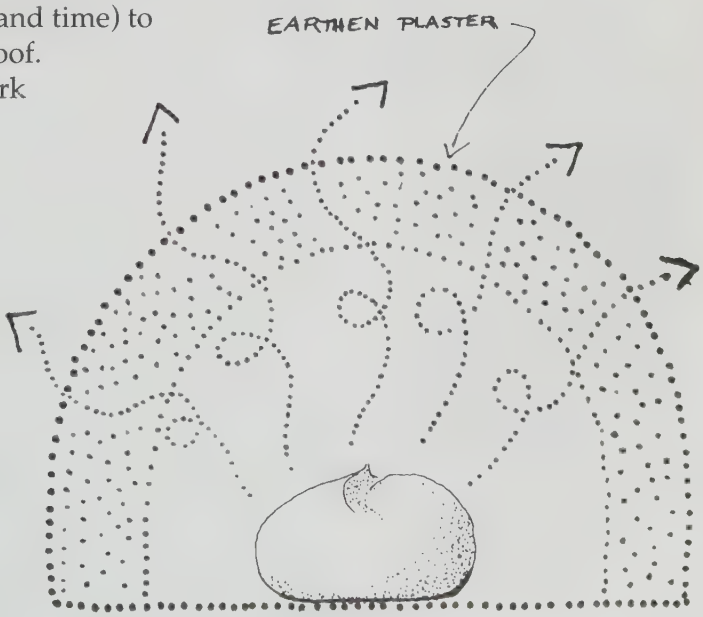
Breathable plasters (like a traditional lime plaster) won't stop saturation from above. The traditional southwestern "hornos" you see uncovered in tourist photos live in a desert environment, and probably get replastered every year. Fair-weather bakers may prefer no roof if a tarp, boards, or an old piece of tin roofing will protect the oven when not in use. And you *can* leave an earthen oven exposed to the elements, and it will both work and last — though it will need regular maintenance, and it's useful life will be shorter. Also, if you bake when it's wet, you'll have to burn up lots of fuel (and time) to dry it out. That's why you need a roof.

A roof will also create useful work space. You don't need to have it all planned out in advance, however. Build the oven in good weather and try it out. See what you need — a spot to rest a tray, or a big table where you can knead dough and lay out all the pizza makings? When you know, plan a structure to suit yourself. A simple lean-to, shed roof, or A-frame isn't hard to make, and photos in the book may give you other ideas. Sadly, I have no photo of one of my favorites: an old auto hood on four poles....

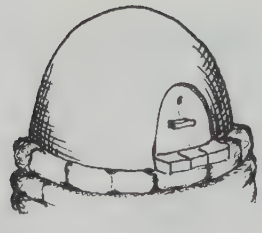


CONCRETE, OR OTHER "WATERPROOF" FINISHES, TRAP WATER VAPOR IN THE OVEN

THE RESULTS ARE NOT GOOD



EARTH "BREATHES," WATER VAPOR PASSES



BEAUTY, SCULPTURE, ART

Earthen building is inherently sculptural; it's hard to make an ugly oven. What you (and all other sculptors) do is reshape space and define new relationships between where you live and what you do. The moment you move a rock, you've changed the space. The more you pay attention, the more beauty you'll discover.

Mud is lovely and easy to work with, and the openings of the oven suggest all manner of real and mythical figures. You can think of it as a totemic structure, a house god, or a piece of abstract art. By itself, the basic oven has all the taut, expectant beauty of a pregnant belly!

BUILDING SOIL: MUD, MASONRY & CLAY

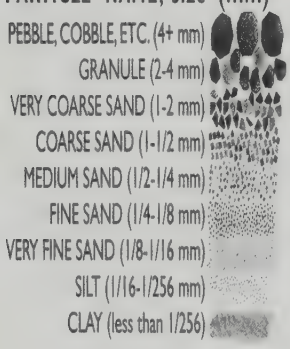
Earth is the most common construction material on the planet. For comfort, beauty, availability, ease of use, ecology and economy, it beats most other materials hands down; indeed, various sources suggest that a third to a half of humans live in buildings made wholly or partially of earth.

The first masons worked with earth, and indeed, the word "masonry" is related to the word "make." (My father says *homo sapiens,* "man the knower," should really be called *homo faber,* "man the maker.") Either way, clay is what makes good building soil.

Fortunately, clay deposits are estimated to be enough to make a continuous, mile thick skin all around the planet! Hence the phrase, "common as clay" — which is also a contradiction in terms, since clay is extraordinary stuff. Science says it may be the prime ingredient of the primordial "soup" in which life originated, since the crystalline structure of clays share a logical "code" similar to that of DNA, the building block of life. Of all earthly phenomena, only two require water for their existence: clay, and life. The Bible says we're made of it: and "Adam" is Hebrew for "red clay."

What distinguishes clay from other dirt is particle size, as well as molecular and chemical properties. Size is very important: a grain of coarse sand falls through four inches of water in one second, a grain of silt takes five minutes, and a single grain of very fine clay can take up to 860 years! Clay is so slow partly because of shape as well as size — particles are thin and flat. Indeed, a single gram of clay can have a surface area larger than a football field. That flatness helps make clay plastic — flat surfaces make it sticky, like two wet sheets of

PARTICLE NAME, size (mm)

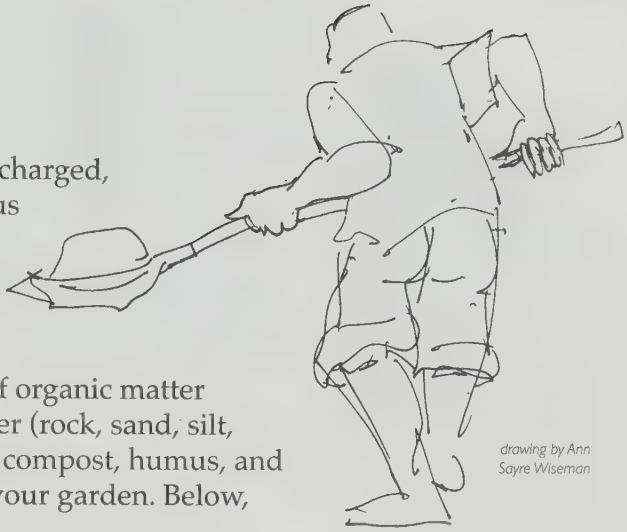


The above chart is adapted from *Sand*, p. 49, Raymond Siever, Scientific American Library, 1988.

RESOURCE

Dirt, the Ecstatic Skin of the Earth, is a compelling and wonderful natural history of what we all come from and go home to; see Resources.

paper. Clay particles are also electrically charged, which means that they have a tremendous capacity to attract and adhere to other molecules (including water).



drawing by Ann Sayre Wiseman

FIND GOOD BUILDING SOIL

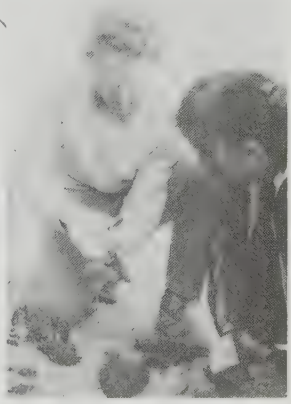
Soil comes in layers: topsoil is a mix of organic matter (decomposed plants) and inorganic matter (rock, sand, silt, clay). Especially when it's full of worms, compost, humus, and lots of organic matter, topsoil is best for your garden. Below, however, is subsoil, which may contain anything from pure sand and rock to pure clay that you could use to make pottery.

What you're looking for is subsoil containing enough clay so it's hard and strong when dry; sticky when wet. Dry, it should feel solid, fairly dense, and tough — a bit like concrete.

CHARACTERISTICS OF BUILDING SOIL

It is harder to dig, and doesn't crumble easily. A shovel leaves a shiny cut mark. When dry, it won't crumble easily. When wet, it grabs boots and tires and won't let go. Dry or wet, however, it will feel slippery and "greasy" (the flat clay particles slide smoothly, instead of rolling and grinding).

Having said all that, it's easy to mistake fine silt for a good clay building soil. Often, however, even silt can be sticky enough to use. The best thing to do is test some, and see how it behaves. As an old English cobber said, "I never met a subsoil I didn't like." Here's some things to do:

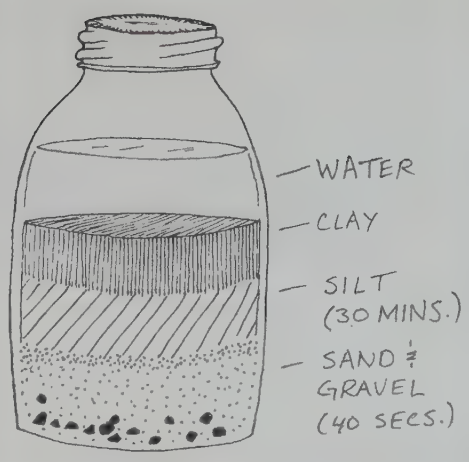


GREASY OR FLOURY? you can learn a lot from just spitting into a pinch of dirt in your palm; what's it feel like?
Michael Smith, photo

A SLOW & NERDY "SHAKE" TEST

This test isn't required, but it makes a good science experiment (indeed, it's a standard tool for engineers and soil scientists) — and it can teach you a lot.

TO INCREASE THE CLAY CONTENT OF A "LEAN" SOIL:
Let it dry, pulverize it as fine as you can, screen out rocks, and soak the rest in water. Mix it up to suspend the clay. Let the coarser stuff settle — anywhere from a 10 to 40 minutes. (Longer settling means purer clay.) Your water should still look cloudy with clay. Pour it off into another bucket, and let it settle again. When the water clears, pour it off, let the clay dry, and see how it works.



The trick to the shake test is timing. In water, particles settle by weight: gravel and sand first, then silt, then clay. Even if you end up with clear lines between layers, you need to know what settled when.

So: pulverize your soil; if it's wet, mash it, no lumps! They sink like stones; you don't want to be fooled into throwing away good material.

Fill a clear jar, half to two-thirds soil, and the rest water; shake hard. Ideally, you'll have some rocks and sand that will settle out in less than a minute; then you'll have some silt that settles out in about 30 minutes; what's left in solution after that is clay (this is a bit sooner than a soil scientist might allow, but it works for me). If everything settles solid and the water clears in less than 1/2 hour, you'll know for sure that you *don't* have any clay!

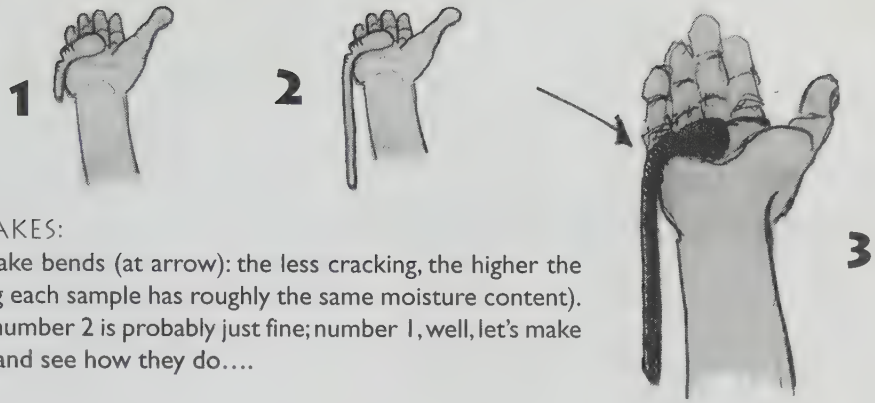
Sometimes it can be hard to tell what's settled and what isn't, but if it slooshes around when you (gently) tilt the jar back and forth, it isn't settled.

There's a large range of workability: some soils settle in just over a half hour with a large amount of very silty clay. Others contain mostly grit and fine sand and a very thin layer of very fine clay — just enough to hold everything together. Some are pure clay that you can use to make pottery.

Don't be too disappointed if your soil seems to "fail" this test. It's easy to mistake settling levels, and what seems like silt often behaves like clay. Try it out first.

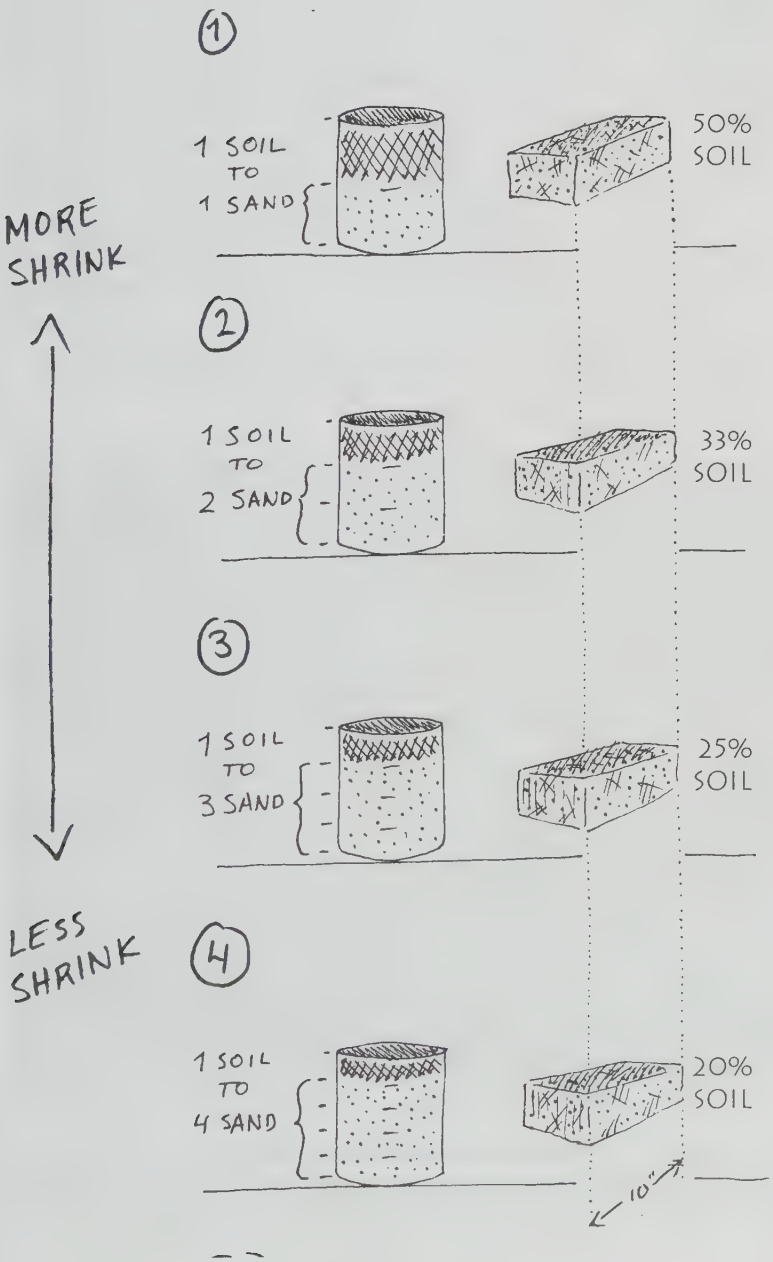
A QUICK & DIRTY "SNAKE" TEST

Mix dirt and water in your palm until you get a smooth, lump-free, and workable golf-ball size glob (wetter is better than drier). Roll it into a snake. If you can get a couple of inches or more, roll your hand over flat. If you have clay, it should bend without breaking. The longer you can make it, and the easier it bends without breaking, the more clay you have. At minimum, you should be able to roll and bend at least two inches of a 3/8" thick snake. At maximum, you'll be able to wind lengths around your finger.



EVALUATING SNAKES:

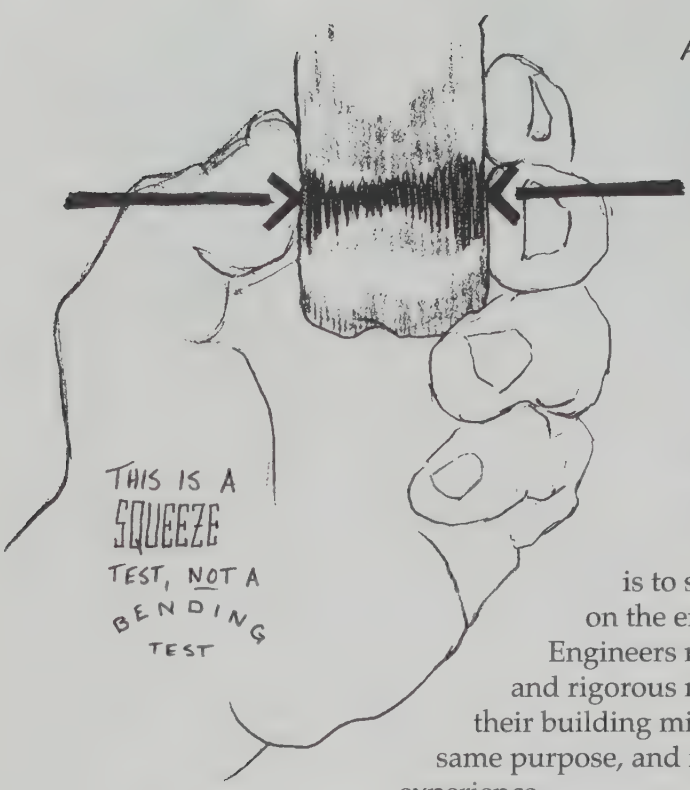
Look at where the snake bends (at arrow): the less cracking, the higher the clay content (assuming each sample has roughly the same moisture content). Snake 3 is rich in clay; number 2 is probably just fine; number 1, well, let's make a batch of test bricks and see how they do....



TEST BRICKS

Make bricks by using different proportions of sand and soil. Dry them, and see how they hold up under stress. You might start with pure building soil, then 1 part sand to one part soil, then 2 sand:1 soil, 3 sand:1 soil, 4:1, etc. Each "brick" should be the same size and well-compacted — by hand, in a plastic container, a loaf tin, or a wood frame: no straw (which prevents cracking and increases strength), and not too wet; about an inch thick, and long enough to make two marks ten inches apart. Let them dry.

When dry, re-measure the distance between your marks. How much did they shrink? Multiply the difference by ten to come up with percent shrinkage (e.g., if they shrank a quarter inch, then, 0.25" x 10 = 2.5%). If they shrink more than two to three percent, you might add more sand. Test them for strength: how easily do they scratch? Can you wear them away with your fingernail, or does it take a piece of wood or a nail?



A SIMPLE SQUEEZE TEST

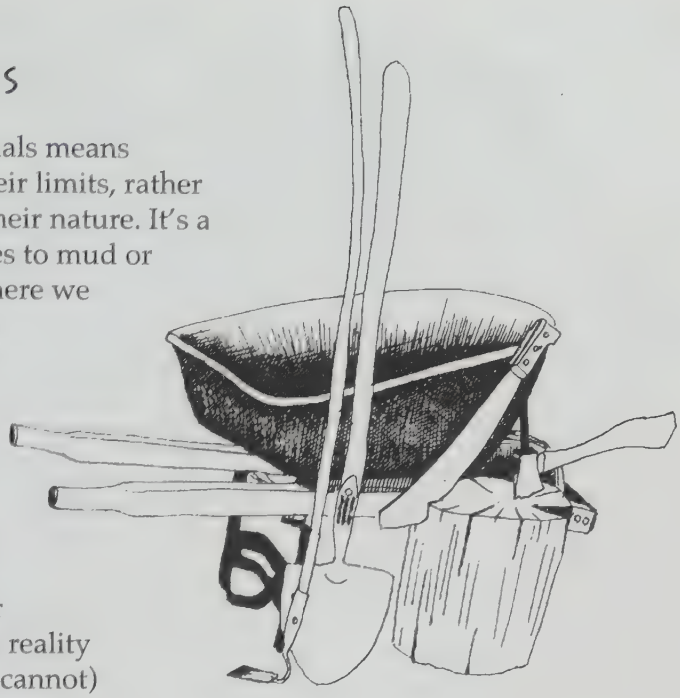
Squeeze a corner of a brick between your fingers. Does it crumble to dust, or is it hard as rock? (The trick here is to apply compressive force without bending. Even the strongest concrete won't take much bending — that's why we have re-bar, and it's also why buildings of earth often have straw mixed in.) You can also try stepping on a sample, or hitting it with something hard.

A typical field test for adobe bricks is to stand on one that's supported only on the ends — if it doesn't break, it's good! Engineers may employ more precise machines and rigorous methods to measure the strength of their building mix, but such simple tests serve the same purpose, and reflect generations of lived experience.

THE TARP TECHNIQUE

Kids mix mud on a tarp at a school in Sweet Home, Oregon. To turn the material, stand in the middle of the tarp, grab an edge, and pull the tarp towards you, while walking backwards. Don't roll your mud onto the ground! Lay tarp out flat. Stomp and turn, stomp and turn.

MATERIALS AND TOOLS



Making the most of your materials means accepting and cooperating with their limits, rather than trying to force them against their nature. It's a basic working principle that applies to mud or people. And there's a corollary: where we find relationship, we will also find beauty. But we have to start where we are. That's why I suggest you make do — not only because it's better than buying, but also because you'll learn more by thinking about where to dig and how to scrounge. Yes, most of the industrialized world is a consumer culture, but we are a minority! The reality is that consumption does not (and cannot) sustain us. Everything comes from and returns to the earth. Scrounging reminds us that there is no such thing as "waste," only gifts we fail to cherish.

If you feel you must buy to "save time," why not let the oven wait? "There is more to life than increasing its speed." Try a one-day, one-layer oven on sawhorses. It can be a practice oven, as temporary or as permanent as you like. Take the time you save to inventory local resources. Try different routes to work and look for materials at construction sites, giveaway piles, or vacant lots. Buy good bread and ask bakers about their ovens (see if they don't get excited when they hear about your wood-fired oven plans). By the time you figure out how and where to make a more permanent oven, you'll not only have located all the right stuff, you'll have perfected your bread, too!

QUANTITIES

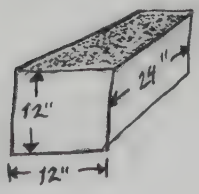
The actual amounts of material you'll need will vary according to your particular design, site, materials, and mix (for more on variations, see chapters seven and eight). I always collect more than I think I'll need — I'd rather have a little leftover than stop in the middle of a project to get more. The chart on the following page offers *approximate* amounts of materials needed for three oven sizes (all multiples of a standard 4.5x9" firebrick): 22.5", 27", and 36". It assumes a 4" thermal layer, 4" insulation layer, and 4" of thermal material under your floor bricks, as well as a 10" high door.

WHEN DOES 2+2 = 3 (OR LESS!)?

Two buckets of building soil + 2 buckets of sand usually = only 2 or 3 buckets of mix. Huh? Since it works as glue, the building soil just fills in the gaps between grains of sand. It's like pouring water into a bucket full of marbles. Keep that in mind as you estimate amounts of material.

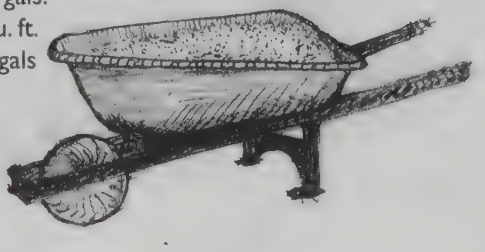
=

(2 CUBIC FT.)



= ± 190 LBS SOIL
± 225 LBS SAND
120 LBS WATER

VOLUMES:
1 cubic foot = 7.5 gals.
1 cu. yard = 27 cu. ft.
1 cu. yard = 202 gals



= 3-4 CUBIC FT.
± 300-450 LBS SAND

OVEN MATERIALS CHART (VOLUME IN 5-GAL BUCKETS)

Oven size	form sand	oven mud	insul'tn. (mixed)	hearth bricks*	arch bricks**
22.5"	4	8	8	13 + 3	10 + 2
27"	6	12	10	18 + 3	12 + 2
36"	11	17	13	32 + 4	12 + 2

Insulation: since it compresses, get half again as much loose stuff.
* Extra "tongue" bricks (see also diagram on p. 38).
** The extra 2 bricks support the ends of the arch (see pp. 40, 45).

HINGED ROOF
Here's a clever, lightweight roof that's hinged, so the whole thing can be tipped to one side for firing during good weather.
Bill Shores, oven & photo

WEIGHT, VOLUME, & HOW TO LIFT A 2-TON OVEN

If all this talk of sand and buckets makes you tired, remember that you can make a small oven (see Effie's 2-loaf model in the color section). But otherwise, just adjust your load to suit your back and arms. Use a measure that you can happily manage. Sand, dirt, and rubble vary in weight, as do buckets & wheelbarrows; if it feels heavy, make it smaller! When I built my 50-ton house, I told people that I could lift it easily — "one shovelful at a time." Later I met a 72 year old gramma who built her own earthen house. "When I got tired," she said, "I'd quit." It took her about two years.

ARDILLA OVEN
Sculpted by the author with children in Tlaxco, Mexico; the squirrel oven lives at the Instituto Alfonso C. Gomez, which seeks to strengthen local rural culture by providing "education to stay," a curriculum based on Mexico's rich heritage of rural knowledge & traditions.

PREP LIST

WATER

A hose — or a big garbage can or 55-gallon drum full of water for dipping out buckets at a time.

FOUNDATION ROCK, OR "URBANITE"

A four foot diameter circular base, 36" high and a foot wide, requires *about* a cubic yard or more of "urbanite" (or rock). Filling it takes roughly another yard of material. If that seems like too much, make it lower, and/or check out other options (see page 39 and the photos, especially).

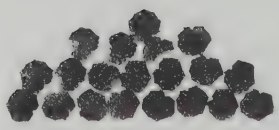
BUILDING SOIL

Most people should be able to find good stuff underfoot. When in doubt, review pages 24-28. If you can't find anything on your site, look for old quarries, riverbanks, ponds, road cuts, building sites, and neighbors' yards. One reader suggested the local graveyard — why not?! But be careful too. Fill dirt from developed sites or old dumps may be full of broken glass or dangerous debris, and depending on where you dig, you may need to ask permission. (Remember that how sandy or clayey your soil is in part determines how much dirt and sand you need.)

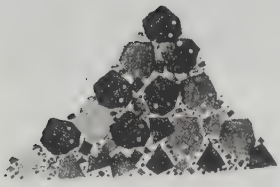
There are places where clay subsoil is either rare or hard to harvest: some coastal regions, in cities where it's just plain hard to dig, or in places where the geology is mostly volcanic.

WHAT IS "URBANITE"?
Keep an eye out for busted-up concrete floors or sidewalk slabs on their way to the dump. Ask at your local demolition contractor or city maintenance yard, or look in the yellow pages for concrete cutting contractors. "Urbanite" is cheap, easy to stack and strong, for oven or house foundations. I first heard the term from David Eisenberg, whose Development Center for Appropriate Technology (dcat.net) is working to make the International Building Code more "sustainable."

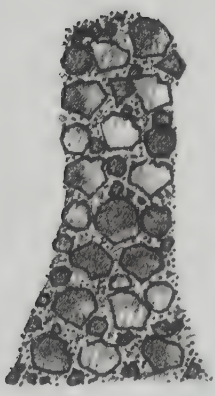
MARBLES: THEY JUST DON'T STACK UP!



BEACH OR GRADED SAND: HMMM, BETTER, BUT ALL THOSE EMPTY SPACES MAKE A WEAK MATERIAL



GOOD SHARP SAND WITH FINES: HOLDS IT'S SHAPE, EVEN WHEN DRY!



GOOD SAND
+ STICKY CLAY-SOIL
= A STRONG WALL!

If that's where you live, look a bit further afield, and/or watch out for wet spots, ponds, etc. (clay keeps water from draining). Find a geologist (at a university or public land agency) and ask them where to go.

If you absolutely can't find building soil, you can often get "waste" clay from a local potter, or from a ceramics shop at the local high school or college. (You may have to soak it, dry it, work it, or all three, but the price should be right. Be aware that potter's clay is very pure, so even if you can't get lots, it may be worth just adding a bit of it to an otherwise unusable soil.)

In a real pinch, you can buy pure "fireclay," dry and powdered, from a building supplier; around here, it costs less than $10 for a 40 or 50 pound bag.

SAND

Sand should be "sharp," rather than smooth or rounded. Particle size should range from 1/4" pebbles to fine powder. What's sold at the building supply as "concrete sand" is usually good. "Graded" or even beach sand typically makes poor building material, not only because it tends to be smooth and round, but also because it's uniform in size. Without a range of particles that will "lock" together into a solid mass, the sand behaves more like marbles, all rolling away from each other rather than settling into a stable mound.

If you don't have a river or creek with gravel and sand bars, look for a local gravel pit, rock crusher, or concrete yard. Especially if you can shovel it yourself into buckets or bags, you may be able to load up for nothing. I've paid $5 — $25 for a pickup load, but the dispatcher at my local yard usually waves away my $5 bill as he calls the enormous front-end loader to fill my little pickup. If you have other needs for sand, you might want a whole dumptruck load delivered to your site, which can be quite cheap.

If you go to the builder's supply, and all they've got is "mason's" sand, that will work, but it will be more expensive, and is generally finer than you'll need. If you're in a more urban area, you might have to buy your sand in bags — the stuff they sell cheap for car weights on winter snow can work.

A sand or gravel pit is just an old bed that the river has abandoned. You may live near an old sand bar where you can dig for free. Sometimes you can dig in old pits that are no longer commercially viable but that still have plenty of material. (Check with land owners and/or other authorities.)

Working quarries often sell useable stuff called "quarter minus," because it's what falls through a quarter-inch screen. Or ask if they have any waste material to give away, like crusher "fines" (the stuff too small to use for gravel), or "scalpings" (dirt and gravel that is scraped off the top of the rock pit). If you want the pleasure of mixing mud with bare feet, though, beware sharp-edged gravel that chews on tender toes!

URBAN MUD
This oven was made in Seattle using "safety sand: sand-in-a-tube car weight," on an urbanite base.
Brooks Stanfield, oven & photo

If sand is in short supply, you can make the oven form with beach sand, topsoil, or other materials — anything you can make into a mound — just be sure it's small enough to fit out the door when you're done! There is also the Canadian style of oven made on a rough basket of saplings that is burnt out. Such ovens were made of pure clay mixed with hay or straw, a simple and adaptable technique.

DENSE "OVEN MUD," OR "THERMAL MIX"

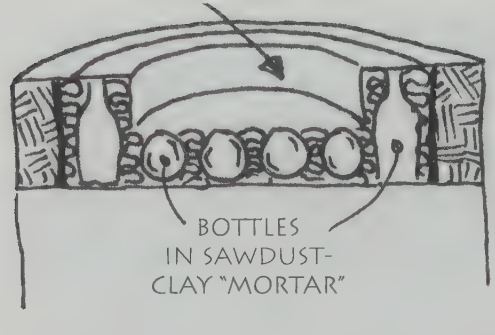
This is just your building soil, either mixed with sand, or pure (if you decide to go that route). Mixes vary, but in general I expect it to consist of one part building soil, and 2-3 parts sand. For now, it's enough that you've found useable material.

INSULATION

You can make insulation from most any woody (natural) material that will mix with liquid clay slip. It should be sabulous (rhymes with fabulous!) and grainy, like sand, fairly uniform, without too much fine stuff, or too many chunks bigger than a fingertip.

Unlike your sand mix, your insulation should have lots of small holes and pores. Look for clean (non-toxic) chainsaw leavings, planer shavings from your local cabinetmaker, sawmill waste, etc. Very fine sawdust works, if it's all you can find, but it holds more water, and so requires more caution (more on that later). "Barkdust" or "bark mulch" from a landscape supplier works, or even a bale of hampster bedding or cedar shavings, but that starts to get spendy.

Mix up a test batch and make a ball. Let it dry. Is it lightweight, solid and tough? Burn it! It should hold it's shape, but may be fragile and soft.



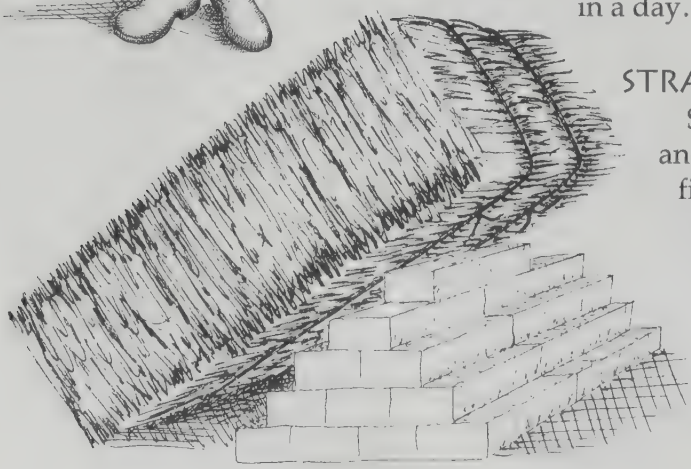
SUB-FLOOR INSULATION MATERIAL

The cheapest and most elegant solution I've tried so far is recycled glass bottles set in a "mortar" of sawdust-clay. The number of bottles depends on how you lay them out and how thick you want your insulating layer. Anything from beer bottles to gallon jugs will work — on their sides, upright, or upside down, depending on your bottles and design.

Pumice and perlite are mineral insulants — obsidian and glass that have been expanded or "puffed" at high temperature — not unlike "puffed" cereal, or popcorn. They are lightweight, fireproof, and strong enough to support weight. (Fiberglass, by comparison, is too soft to support weight or to resist compaction when mixed with mud — not to mention being a nasty material to work with by hand.)

Pumice is made when volcanoes spew molten rock into a cooler atmosphere. Perlite is an industrial equivalent made in a kiln. Both mix easily with clay to make good material. The cheapest place to find them is likely to be your building or landscape supplier. Of the two, the building supplier is preferable, since "insulation grade" perlite is treated to reduce absorbency, thus reducing drying time. You might also try garden suppliers or plant nurseries that make their own potting soil. Vermiculite is similar to perlite, but softer and a bit harder to work with. All make nasty dust that you won't want to breathe. Use a respirator.

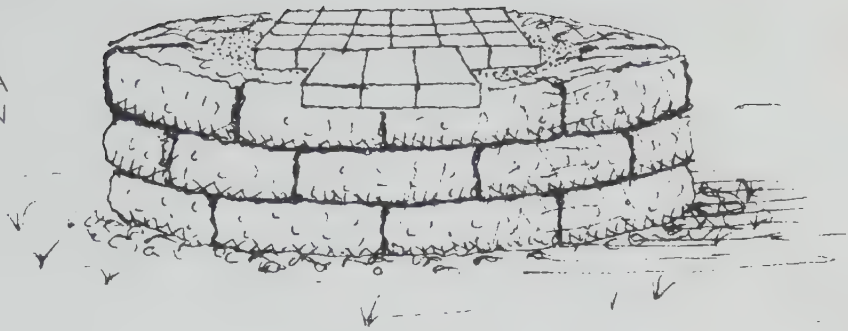
Whatever you use, it's good to let your subfloor insulation dry before building on it, since squishy, wet stuff can move when you put weight on it. (But I don't always follow such advice, especially when I need to make an oven in a day....)



STRAW

Straw is used for making sculptural and structural mixes or, if you can't find sawdust, for chopping up into insulation. A two-string bale (about $5 or less) should be enough. Or ask for spoiled bales, or to sweep loose straw up off the floor (it's mostly air, so get a lot; leftovers are great for the garden!)

HEARTH BRICKS & A LOW FOUNDATION



HEARTH FLOOR

Standard dense "firebricks" are 4-1/2 x 9 inches, but you can also use standard red bricks (3.75x8"). Firebrick is so-called because it's manufactured specifically for use in fireplaces or stoves, and is widely available from most suppliers of masonry materials. Mostly, it's yellow, dense, heavy, and absorbs and holds heat. If you get ones that are light and soft, they may be insulating bricks — not what you want, as they are very soft and weak, and hold very little heat.

Standard red bricks are less standard, and while the right red brick will make an excellent oven floor, it takes a bit more care to be sure about what you've got. In general, the softer, more porous brick will hold up better to heat shock. Newer bricks (decorative "facing brick," or "pavers") tend to be harder and more brittle, and more likely to fail with repeated heating. Some aren't even brick, but cast concrete, which degrades in an oven. Older (pre-WWII) bricks are generally more reliable, especially if they came out of a chimney or fireplace.

I've paid from $1-$3 for new firebrick, about half price for used. Used bricks should be as smooth and flat as possible, and free of old mortar.

There are other options: Mexican "saltillo" tile is often quite resistant to thermal shock, and can be affordable and easy to find, new or used; the thicker the better — also, make sure it's *un*glazed. You could also use an old baking stone or, if you're a potter, a kiln shelf (free of toxic glazes, of course).

Stone, with the possible exception of soapstone, is not recommended for floors. Soapstone, because it retains so much heat as to burn the bottoms of your loaves, is sometimes used as a subfloor heat-sink, or for pizza ovens. If you use it (look for old soapstone sinks), it should be dried slowly and heated carefully, since trapped moisture can build explosive pressure, destroying your floor and possibly causing you bodily harm.

A TRADITIONAL EARTHEN HEARTH

You can make your own bricks or tiles from your own soil. You'll need to pre-fire them, to reduce problems related to shrinkage and cracking (try a primitive "pit kiln," or the one described on page 104). Or mix your building soil with sand and fire it in place (it may be soft; beware grains of sand on the bottom crusts of your bread). One reader reported seeing Majorcans use "an old European oven floor recipe" made of lime putty, wood ash, and sand. Try starting with a mix of one part lime, 1/2 part ash, and 3 parts sand, and experimenting from there (see page 64 for more about lime). Some traditional middle eastern flatbread ovens have loose pebble floors (does the extra surface area make for faster cooking?) Buyers are responsible for picking out stones that stick.

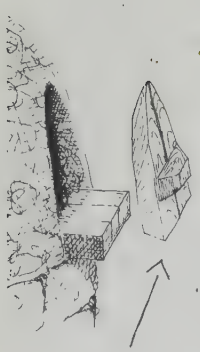
READY FOR OVEN MUD
oven form, covered with newspaper.
Jann Hutchings, photo

NEWSPAPER

This makes a parting layer between your sand form and the oven mix. You can also use plastic, but newspaper doesn't leave any toxic residues if you end up having to burn out leftover scraps. Leaves are more natural, though potentially more tricky.

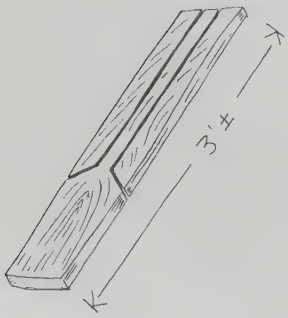
BRICK DOOR ARCH (OPTIONAL)

You'll need about a dozen extra firebricks, plus scrap lumber and plywood for an arch form.



MATERIALS TO MAKE DOORS & OVEN TOOLS

- Scrap wood, 1-2 inches thick, to make a door approximately 10x14 inches (1x4 or 2x4 scraps work well and can be held together by the handle assembly). Add stock for a handle, plus a piece of plywood at least 1/2" larger than your door, and nails or screws as needed.
- 1x6 scrap lumber, three to four feet long, to make "peels," for loading and unloading loaves and/or pizza; or three feet of 1x2 and enough masonite or thin plywood to make peel(s) the right size for your loaves and/or pizzas.
- a branch or 1x2 stick about four feet long, clean rags of cotton or other natural fiber, a piece of stiff wire, and a nail or screw, to make a "scuffle," for cleaning your hearth floor:
- Metal "weed whip" or a bent length of steel bar, to make an oven rake, or "rooker:" You can also use an old hoe or shovel to empty coals from the oven.



PHOENIX OVEN & BENCH, NEW MEXICO, USA

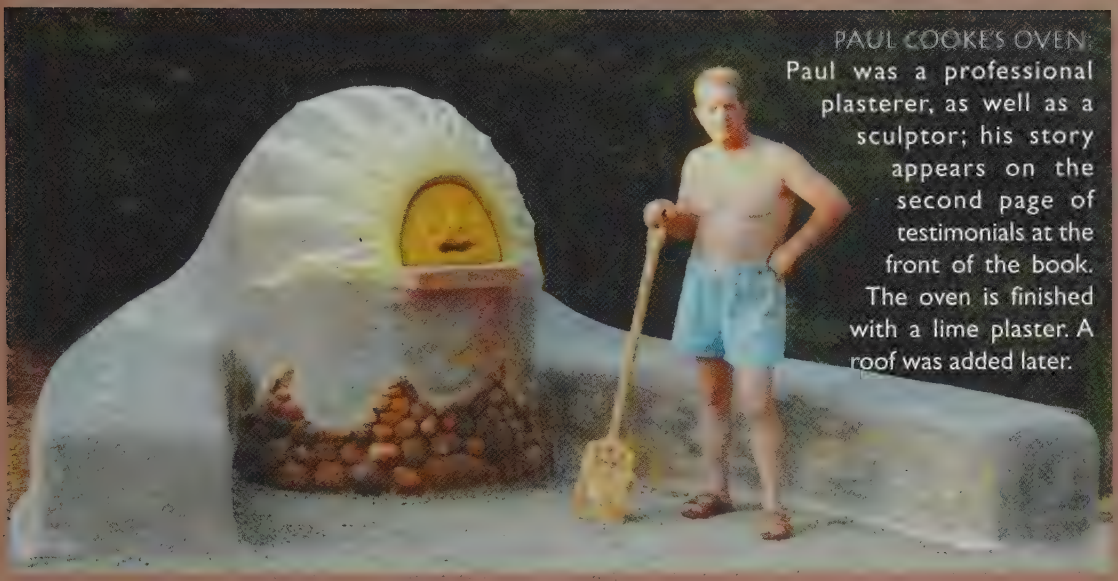
We started with an old adobe "horno." Curved benches on either side suggested wings. The young woman above was first assistant, scores of natural building colloquium participants also helped, over two weeks (a few of them gather above). The site is The Black Range Lodge, in Kingston, formerly abandoned but now restored as a B&B and center for natural building; thus a Phoenix rebirthing itself from the ashes. The oven is in the bird's belly, and smoke vents out the beak. *Kika Denzer, oven & photos*

Oven with firing door: a bright, hot fire.

FALCON OVEN & DETAIL
The oven is shared by residents of a housing development in Newport, OR. It is finished with a lime plaster and painted, fresco style, with oxides of iron (powdered cement pigments mixed with lime water). A sculpted ferrocement dome shelter was added later. (see photo on page 65).
Kiko Denzer, oven & photos

Below: Brooks Stanfield's oven, with mosaic work set into the final mud plaster
Brooks Stanfield, photo & oven

TARA JOHNSTON'S OVEN (OPPOSITE):
"...is attached to a large cob sauna, outdoor kitchen and bathhouse owned and dreamt up by Aaron Blake and Christina Davis.... We started with a sketch..., then laid it out in garden hose, and figured we'd create the rest as we went. It is the inside curve of a large spiral ... that conclude[s] with the oven .... When we had work parties, we would ask folks to bring things to put in the walls .... There are prayers, and memories, wedding rings and seedpods from a Vietnam homeland in those walls...."
Tara Johnston, photo & oven



PAUL COOKE'S OVEN: Paul was a professional plasterer, as well as a sculptor; his story appears on the second page of testimonials at the front of the book. The oven is finished with a lime plaster. A roof was added later.

OBLIO THE COB FROG OVEN... was built to complement the ongoing community-gathering-in-the-street intersection events that have been a tradition in ths Portland (OR) neighborhood since 1996. The street in front of Oblio is closed to make a place for tables and chairs where families gather to roll dough, chop vegetables, and consume pizza, with kids running all over while the parents check the progress of the pies.... Oblio was built as part of City Repair's 2003 Village Building Convergence, in "Share-It Square," at the home of Drs. Kelly Fitzpatrick & Geri Ota (pictured). Neighbors all over the country are starting to follow Portland's example of using cob and other natural building methods to "repair" empty intersections by building ovens, benches, kiosks, and other social magnets that restore the "public" in public space. Janell Kapoor, Meka Bunch, Lynn Doiron and John Black led the project.... *Roof (and photo) by mOceaN Lakeman.*

WALDORF OVEN, WASHINGTON: Warren Cohen, center, taught third grade in Tacoma Washington. He and students Michael Kelly and Avery Wilkin, built this oven for a class auction. They tested it at a gala house-warming party. Warren said, "all the guests abandoned the beautifully catered food and began devouring plain, simple bread and butter.... People were in fresh baked bread euphoria — a success!" *photo courtesy of Warren Cohen*

MELANIE HEISLER'S OVEN: Built in her San Francisco yard with friends Jeff Moroso, Robin Stice and Robin's kids Robert and Sara — plus Raoul and Dolly, the chickens. *photo courtesy of Melanie Heisler*

WALDORF OVEN, ASHLAND, OR

Debbie Murphy's third-grade class built their own turtle oven over the course of a school year. Debbie wrote that "we were so excited to have our first fire in the oven just before school ended." They put their first loaves in a bit soon so they came out a bit dark, but "perfect inside." Anticimpatience.... *photos courtesy of the builders*

CANDY VANDERHOFF'S 3-CHAMBER OVEN

"(It) changed my life and made me healthy and strong... I had no idea it would be so big and so beautiful... the blue glass ball on the top has a small mirror embedded in front of it, to the south. On the winter solstice at noon the sun lights up the blue glass. So it's a calendar too." The design includes various baffles and a double flue (one for starting the fire, the other to draw heat through the oven and then through a vent that spirals around the exterior of the dense layer). The hanging teapot can be heated by a fire in the pit below. The exterior is finished with linseed oil, and it's tarped for the short rainy season. At press time, she'd just baked 14 loaves of Moosewood gingerbread for Christmas presents. In addition to baking, however, it also lent inspiration for an effort to help empower local women and create common ground for the whole community, a need Candy identified after two years of standing in protest to the Iraq war and being "counter-protested" by another group. Her idea was to build community, to empower women as builders, to demonstrate earth-friendly materials and technology, and to reclaim an unused part of San Diego's Balboa Park. So she wrote to the park board with a proposal for a temporary cob and strawbale "poetry bench installation." After the board said yes, she invited a slew of people to her house for mud-oven baked treats, made a demo batch of cob, and got 20 signatories. The bench was done in four weekends. *Candy Vanderhoff, photos*

EFFIE'S ROBI'S OVENS

"After receiving your book I built a small oven with much success! I dug clay from a creek about 10 miles up the road...there was plenty of sand to be gathered from a dry wash near my cabin. ...We found some old tiles from Mexico in a junk pile and they soon became our oven floor.... I fooled around with different sand/clay ratios....The red color — hematite — a common iron ore here — we painted on once the oven was finished. ...It holds about two loaves of bread which is just perfect for us.... I've baked potatoes and corn and beets in the oven, too."

— Effie, from Arizona's Prescott College, also did an independent study on the culture and tradition of the southwestern "horno."

Robi Dawson (in orange) helps his neighbor with an oven in Budapest, Hungary. Nice shape! *Photo courtesy of Robi Dawson.*

Here's a spread from a fairly typical summer oven firing at home.

KELLY'S OVEN:
...Is a wonderful example of using simple pattern and textural treatments to enhance the basic oven shape. A potter, Kelly said she "had a wonderful time making my oven ... it's covered with a black vinyl grill cover ... not rustic but it works ... I think the ability to use our hands and make the things we use is more important now than ever." *Kelly Averill Savino, photo & oven*

MAYA' AT INTABAS WILDFIRE RESTAURANT:
In Corvallis, Oregon. Former lead baker Kirsten Schumaker (in photo) named the oven after a Hindu goddess of creation. The hearth floor is four foot square; the dense layer is a foot thick; that's wrapped in a foot of loose pumice insulation. The fire is banked and the door shut about 10 pm. Next morning she's ready to bake bread. Around her exterior, she's 9 feet in diameter. See "Maya's homepage" at intabas.com for construction details. *Ozean Anderson, photo*

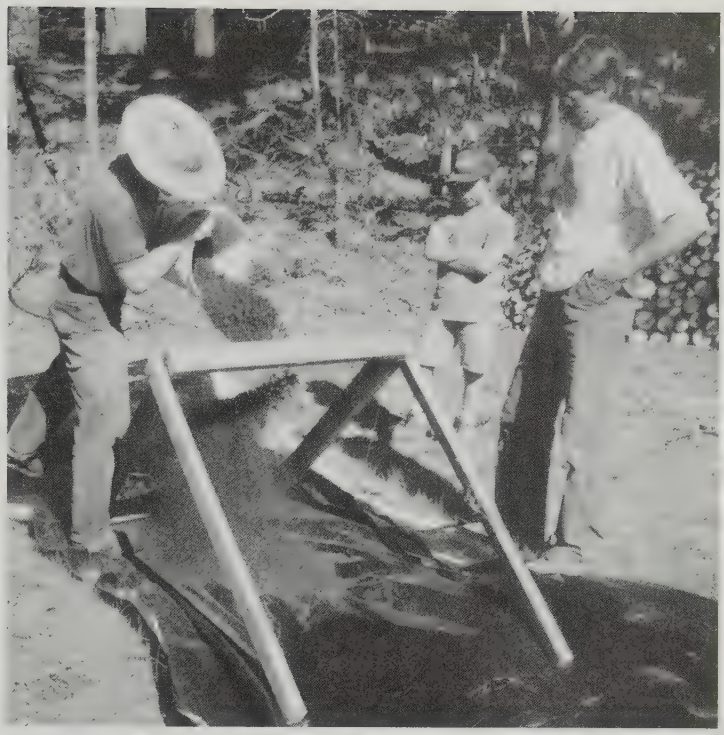
ART, SCULPTURE, HARMONY:
After she'd been living with a dragon outside her kitchen window for a few weeks, Courtney Rogmans realized that the whimsical creature was a bit much to live with. Just taking the color off "toned it down." (Yes, it does breathe smoke out the nostrils!) Constantin Brancusi said that "sculpture must be lovely to touch, friendly to live with, not only well made:" ...good words to keep in mind when you get excited about creative possibilities. Art shares a common root, "ar," with the words *harmony* and *order*. So it seems to me that sculpture must not only express the sculptor's self, but also the larger self with whom we try to harmonize our individual lives. Sculpture takes up a lot of space —perhaps for generations to come. *Rogmans, photo, oven by Brian Baker*

THE ENGLISH MUV'S OVEN
The base is a (well-insulated) pallet on a stump. The roof is corrugated tin. The author and his (English) wife built it for their English Muv prior to their wedding, and fed the guests great pizza. *Gail Field, photo*

DENNIS' OVEN
Dennis Tank said of his oven: "It gave me a chance to be the sculptor, the folk artist, that I'm never going to be. Yes, it's an oven, but to me, it's also a real piece of art." The base is made of recycled cobblestones. *photo & oven courtesy D. Tank*

OVEN-BUILDING TOOLS

- Shovel
- Wheelbarrow
- Five-gallon plastic buckets (free from bakeries &/or contractors; 2 or 3 is nice)
- Tape measure
- Tarps: 6x8 foot min.; a bigger tarp turns a heavy load more easily. Woven plastic lumber wrap (in the dumpster at the lumber yard) is "waste" that is sometimes stronger and more durable than blue tarp — but free! Tyvek or Typar housewrap also works, and scraps are sometimes available at construction sites.)
- spoons, spatulas, dull knives, etc.,
- lumber scraps (1x4; 2x4; etc.)
- old clothes to get dirty in, and boots if you don't want to go barefoot
- basic carpentry tools: saw, hammer, drill; and fasteners (screws/nails).



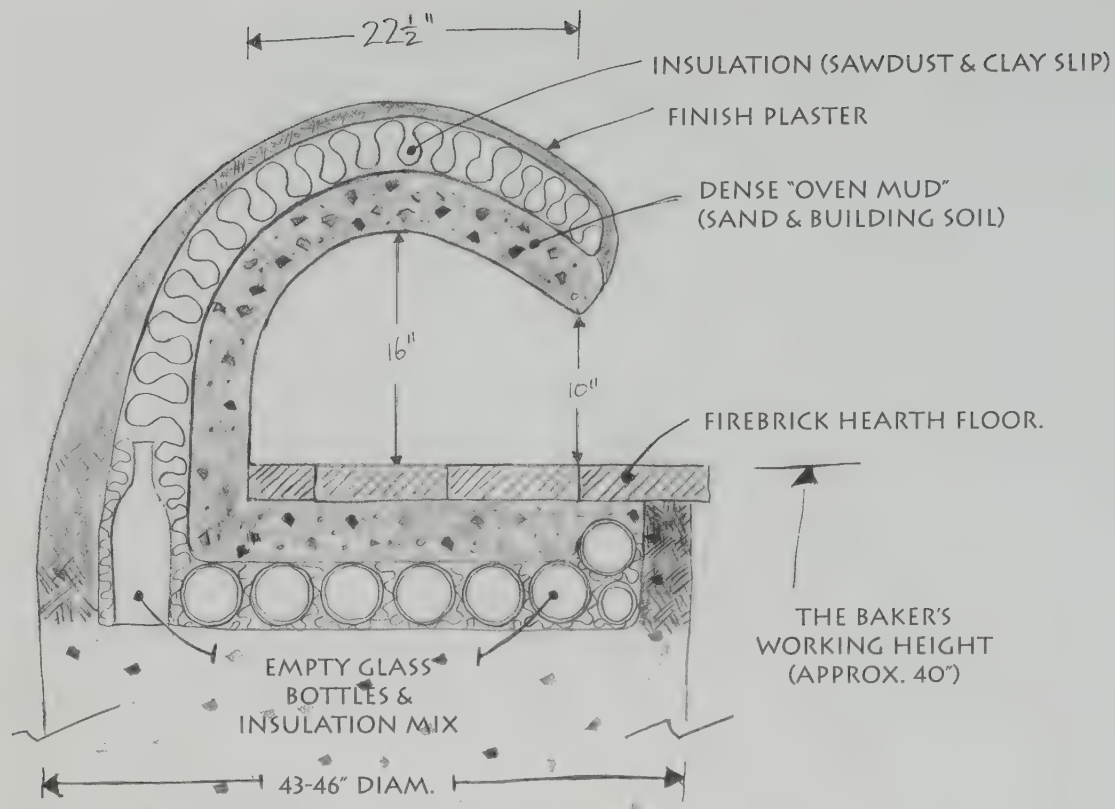
SCREENING DIRT
A frame like this, with legs to hold it at a good angle, makes it easy to screen quantities of material. A tarp keeps everything tidy, and a steeper angle screens out smaller stuff.
Hannah Field, photo

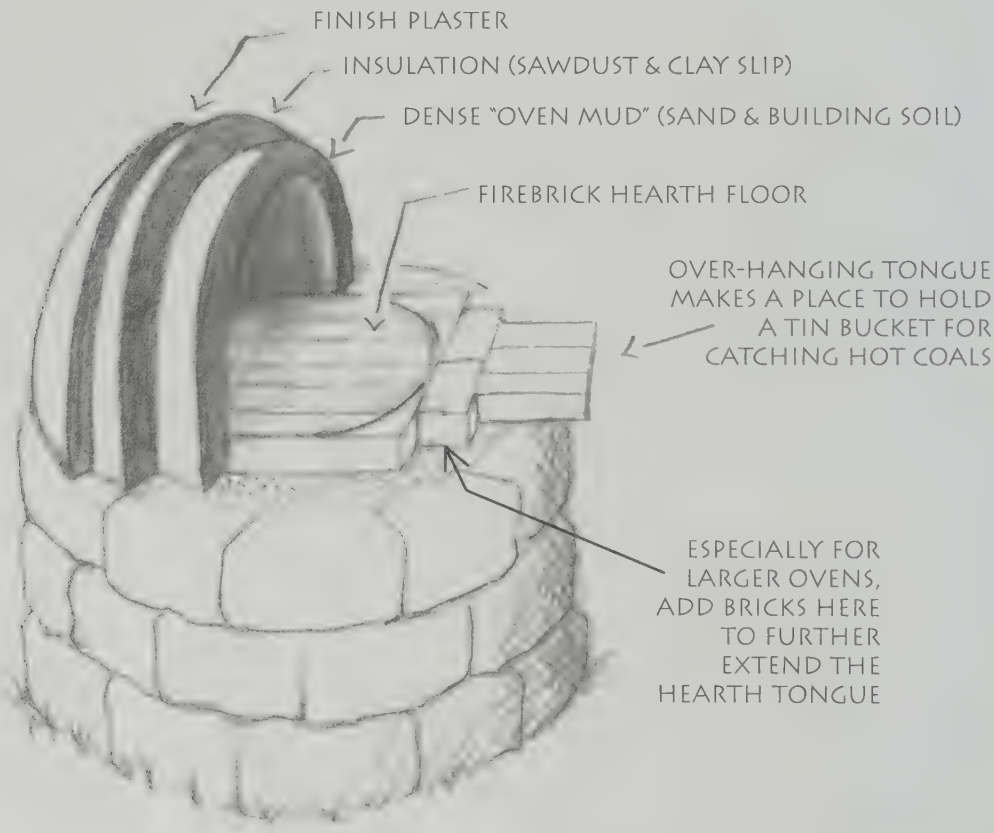
OPTIONAL

- 1/4 or 1/2 inch mesh ("hardware cloth") on a wood frame 2x2 foot or larger; or any other tough mesh that will work for screening sand, soil, and straw.
- spirit level, two or four foot
- machete, hatchet, or weed whacker and large garbage can
- spray bottle/mister
- a professional-grade or heavy-duty electric drill with a drywall-mud mixing blade, for quick and easy production of clay-slip (see illustration, p. 41)

ORGANIZING YOUR WORKSPACE

You'll need space to mix materials on a tarp — at least enough for the tarp, but also think about where you'll be storing your materials, where you'll be mixing, how you'll get mixed mud to the oven site, and how much space you'll need for helpers, tools, materials, etc. A cramped space can make even more work than one where the materials are far away, so it's worth spending the time to get organized.

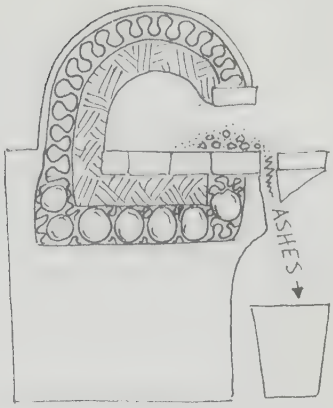

22½"
INSULATION (SAWDUST & CLAY SLIP)
FINISH PLASTER
DENSE "OVEN MUD"
(SAND & BUILDING SOIL)
16"
10"
FIREBRICK HEARTH FLOOR.
THE BAKER'S
WORKING HEIGHT
(APPROX. 40")
EMPTY GLASS
BOTTLES &
INSULATION MIX
43-46" DIAM.


FINISH PLASTER
INSULATION (SAWDUST & CLAY SLIP)
DENSE "OVEN MUD" (SAND & BUILDING SOIL)
FIREBRICK HEARTH FLOOR
OVER-HANGING TONGUE
MAKES A PLACE TO HOLD
A TIN BUCKET FOR
CATCHING HOT COALS
ESPECIALLY FOR
LARGER OVENS,
ADD BRICKS HERE
TO FURTHER
EXTEND THE
HEARTH TONGUE

CHAPTER TWO: STEPS TO AN OVEN

INTRODUCTION

The following steps and dimensions make a fully insulated, twenty-two-and-one-half inch oven similar to the illustrations at left. However, please adapt it as needed. Options like a brick arch or ash dump are covered separately. The foundation can be round or square, stone, concrete, urbanite, cob, or some creative solution based on what you have. If you're building a larger or smaller oven, get a clear picture of what you're doing by copying the basic plan drawings and inserting your own numbers.



OPTIONAL ASH DUMP DESIGN

If you're going to be using your oven daily, you might want an ash dump. If so, you'll want to plan and design for it. An ash dump is basically a slot in the hearth floor large enough to pass coals and ash into a metal bucket below (it should have an airtight lid). In addition to convenience, it can make an oven site safer by limiting the potential escape of hot coals. It does make the design a bit trickier in that the slot must not compromise the integrity of the foundation, the insulation, or the hearth floor. It should also be well in front of the door, and closeable, to prevent squirelly air currents interfering with good draft & combustion.

STEP ONE: FOUNDATION

Your foundation needs to do four things:

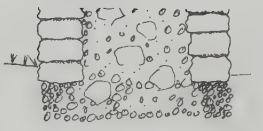
1. protect against ground moisture;
2. support the weight of the oven;
3. keep the whole structure rigid, so it won't shift when the ground gets wet or freezes;
4. raise the oven to your desired working height (lower is easier to build, especially if you don't mind kneeling).

OPTIONS

Before you decide on a full masonry foundation, consider some simple options. Your oven probably won't need to last 1,000 years. Use your imagination and whatever you can find: five-gallon buckets filled w/cement, barrels, boxes (washing machines?), railroad ties, logs, metal wheel rims, tires filled with sand or earth, or wire fencing filled with rubble.

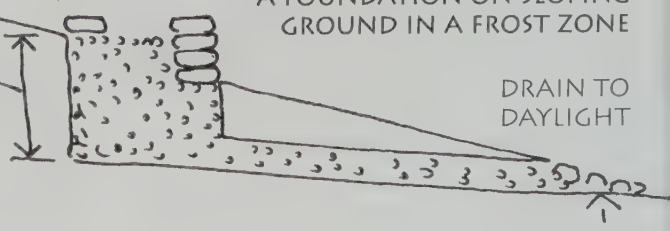
A cautionary word: when I've built an oven on a wood base, it's been either temporary, or *extremely* well insulated, with at least 6 inches of fireproof insulating material between the bottom of the subfloor and anything flammable. They are also safely situated, *outdoors*. Please don't take any chances.

You can also build a fine permanent foundation out of cob. To protect against rising ground moisture, lay a "capillary break" of at least one course of rock or urbanite above grade, and/or use a dampproof material like tarpaper.



A FOUNDATION IN A MILD ZONE

FROST LINE VARIES — THE COLDER YOUR WINTERS, THE DEEPER YOU SHOULD DIG — ASK A BUILDER.

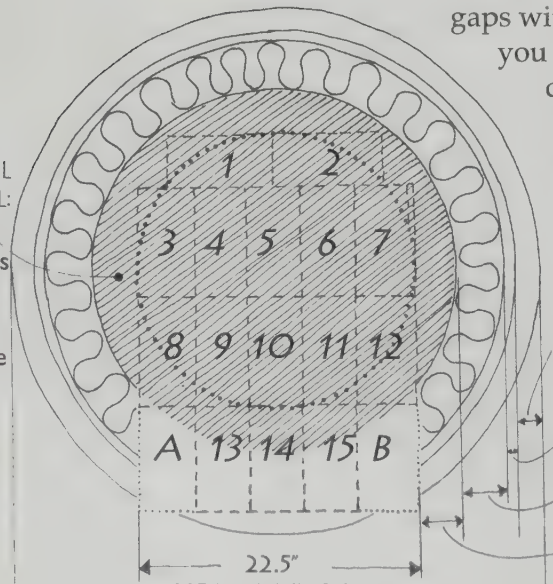


DIG YOUR FOOTING

Mark out a 46-48 inch circle where your oven will be; for any other size, give yourself enough extra width to accomodate "containment rings" for subfloor insulation.

Unless you're building directly on an existing concrete pad or driveway, dig down to the frost line (ask a local contractor how deep that is — if you're in the frigid north and don't like the idea of going down 3-4 feet, ask about insulated foundation systems — options include insulated "floating" slabs, and well-drained rubble trenches). The bottom of the hole should be firm and solid; if necessary, tamp it down with a 2x4, pole, or other implement.

Fill the hole to ground level with drain rock and rubble (or anything that will be firm, but allow water to drain — if you have masses of urbanite, use that; fill gaps with sand or gravel rather than soil, if you can. Otherwise, don't worry.) Round drain rock will settle quite well by itself; but other stuff should be tamped solid.



DENSE THERMAL MATERIAL: hatched area shows extent of subfloor; dotted line shows inner perimeter of oven walls.

3-6" CONTAINMENT RING

1" FINISH PLASTER

4" INSULATION LAYER

4" THERMAL LAYER ("OVEN MUD")

22.5" HEARTH FLOOR

43-46" TOTAL. (ADJUST WIDTH AS NEEDED FOR A SMALLER OR LARGER OVEN)

NUMBERED BRICKS SHOW RELATIVE PLACEMENT; OPTIONAL BRICKS "A" & "B" SUPPORT A BRICK ARCH *(SEE PHOTOS, PP. 45, 49)*

If your ground is very wet, you may want to dig a drain trench (with or without plastic drain pipe at the bottom), to lead water down and away from your oven site, to a place where it can naturally flow away. If you're building on a slope, make sure the foundation hole is level (soup shouldn't spill out of the soup pot). Use a level if you like, but for such a small foundation, trust your eyes. Or test it with the soup pot.

FIRST COURSE

Lay out your ring of rock or urbanite. Fill it with drain rock too, or other rubble, sand, or gravel. (Filling with drain rock insures that water won't "wick" up into the oven. It is important to have this "capillary break" between an earthen structure and the ground — six inches is a minimum. Soil fill is a poor choice, as it doesn't compact completely, and will wick any water it comes into contact with; as it settles over time, your hearth floor may sink.)

ADDITIONAL COURSES

Lay successive courses with staggered joints, like bricks, "one over two." They should sit firm and solid; if one wobbles, stabilize it with chips or pebbles — or make mortar of cement, or mud (same as your oven mix). Fill the foundation with rubble or drain rock as you go up; keep it roughly level. Stop ten or 12 inches below your final floor level (actual dimensions will depend on the thickness of your floor insulation).

STEP TWO: INSULATE YOUR FLOOR

Insulating the floor helps keep heat from being sucked out of your hot hearth into the cool foundation and ground below. (This is *very* important for good performance; see chapter six for reasons why.)

INSULATION CHOICES

My preferred materials are:

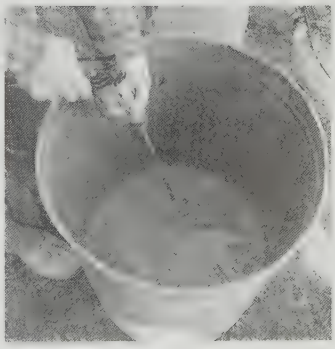
1. recycled glass bottles set in a "mortar" of saw-dust clay (cheap & reliable);
2. mineral insulant (pelite or pumice) mixed with clay slip (more expensive and dusty, but easy and reliable)

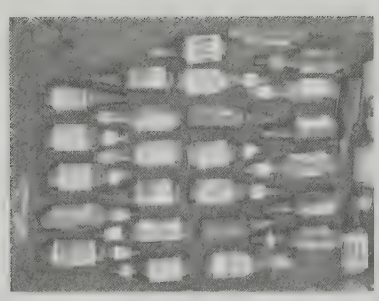
Clay slip is just your building soil mixed with water. See the sidebar for details.

MAKING CLAY SLIP

Break up dry building soil to the texture of coarse gravel, and pour it into a bucket 1/3 to 1/2 full of water (pour off excess). Let stand overnight, and stir! Or combine mud and kids in a kiddie pool or on a tarp! Consistency should be like very heavy cream. If you're pressed for time and so inclined, make a "bucket blender:" I use a long "whisk" bit (designed for mixing sheetrock mud) on a 20 year old, heavy duty 3/8" Porter Cable drill. Beware the big half inch drills that can break a finger or wrist.

B. Carlson, photo



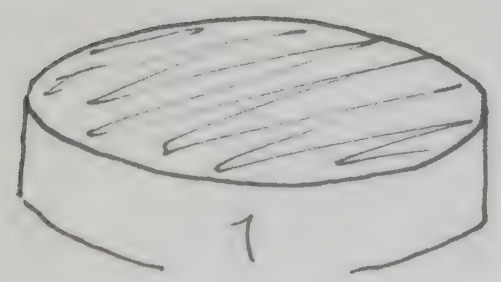


BOTTLE INSULATION

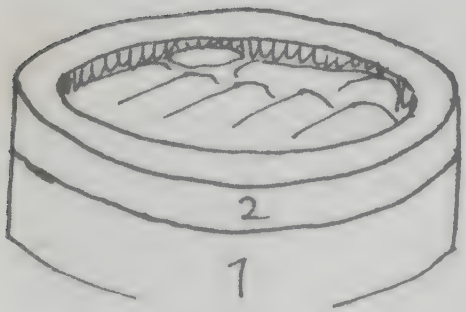
Glass bottles should be roughly the same size, either on their sides, or straight up, and spaced to provide good support to the subfloor above (on their sides, gallon jugs would leave big gaps; flat end up is better).

MINERAL AND SAWDUST INSULANTS

Mineral and sawdust insulants should be mixed with just enough clay slip to make a firm dough. Fill a wheelbarrow half full of insulant, pour in a gallon or so of slip, and "fold" it with a shovel, like a huge batch of pancakes. You should be able to pack the dough into a ball. Too much slip makes it drip, too little makes it crumble. If you use sawdust, the clay coating makes it fireproof by keeping out oxygen (at high enough temperatures, the sawdust will (slowly) burn out, leaving nothing but a kind of clay "foam"). The clay makes it moldable, increases compressive strength, and reduces dust. Use a respirator with any dusty minerals, especially perlite, clay, or anything containing silica.



1: TOP OF FOUNDATION



2: FIRST RING WITH SUBLFLOOR INSULATION READY FOR SAWDUST-CLAY FILL

MAKE RINGS TO CONTAIN SUBFLOOR INSULATION

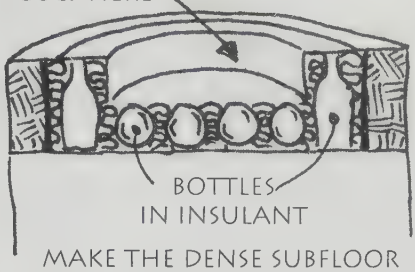
Remember that insulation works best if it completely encloses the mass of the oven, like the chocolate around a peanut M&M. But we need to start with the chocolate! To contain it, you'll make a mold of sorts. The drawings show narrow-ish rings around the outside edge of your foundation (#2, in the diagram at left; #1 is the top of your foundation.) Use cob, bricks, or what-have-you. Make the ring as high as your insulation will be thick. Arrange the bottles with 1/4" - 1/2" gaps (filled with insulant, these cushion the bottles against breakage due to expansion). Make the finished surface roughly level, with bottles just visible.

If you like, you can stop here for a few days while it all dries (fill up any cracks). Or keep right on going. Next is a dense subfloor.

DENSE SUBFLOOR, OR HEAT SINK

Traditionally, hearth bricks were set on a layer of dry sand, both to soak up and store heat, and as bedding for the hearth. Although

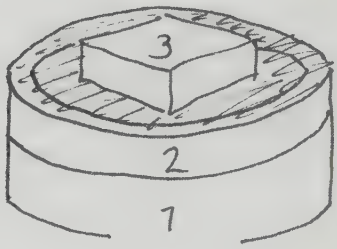
Note the brick ring. Brooks Stanfield wrote of his oven that *we've been really impressed with the limited…firewood needed to get this thing hot enough to bake a pizza in about 90 seconds AND how long the oven retains that heat.…we use about 1/2 to 2/3 of an 18" round of firewood and that's it.*



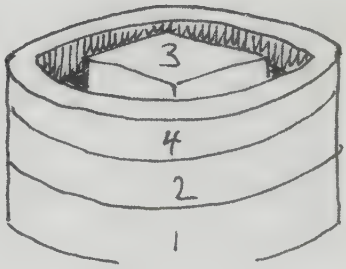
MAKE THE DENSE SUBFLOOR BEFORE OR AFTER YOU MAKE THE RINGS; IT CAN ALSO BE SQUARE OR ROUND, DEPENDING ON WHAT MAKES MOST SENSE FOR YOUR SITUATION & MATERIALS

it's easy, dense, and suggests good heat storage, even tamped sand has numerous air pockets that neither hold heat nor insulate. I've switched to making a bed of dense oven mix, on the assumption that the clay will fill air cavitities and improve heat transfer (and storage). It's also easier when you go to wrap it with your insulating material. But either way works.

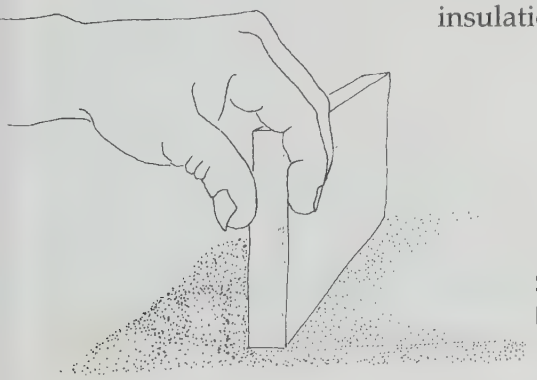
Locate where on the platform the edges of your hearth floor will be. Make a temporary form of lumber or bricks. Fill with oven mud, and tamp solid to make a pad big enough to support the whole hearth (#3 in the diagram). Depending on your situation and materials, you may find it easier to make the last containment ring first (#4), line it with a band of insulation, and fill that with a round disk of dense material (use cardboard or the like to hold back the insulation).



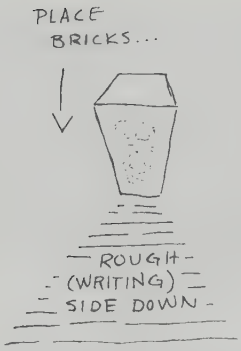
DENSE SUBFLOOR ON INSULATION; IT SHOULD BE BIG ENOUGH TO SUPPORT ALL THE HEARTH BRICKS



WITH INSULATION IN THE GAP BETWEEN (3) AND (4), THIS WILL BE READY FOR SCREEDING & HEARTH FLOOR BRICKS



PREP A FLAT SURFACE FOR HEARTH BRICKS
Screed off the top of the tamped subfloor with a straight board prior to laying floor bricks. It helps if the screed can ride on flat surfaces or "runners" at either end.



A BETTER MUD BED FOR THE FLOOR

Mud mortar "grabs" bricks securely and can make levelling a bit more precise (if tricky). It's like setting tile: rake the bed with a toothed trowel or a stick. Before setting, soak bricks in water or they'll suck it out of your mud, which will stiffen up too fast. Permanent cement is *not* advised because it makes replacement difficult.

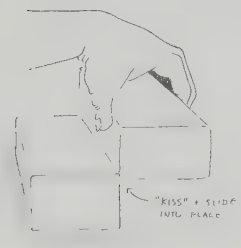
STEP THREE: MAKE YOUR HEARTH FLOOR

SET YOUR FLOOR BRICKS

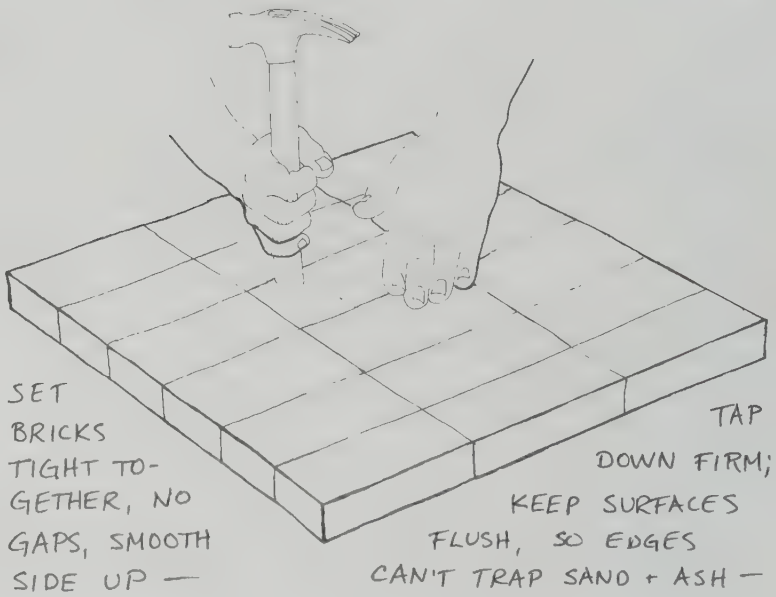
The more even and flat your hearth floor bricks, the easier it will be to work in your oven: loading loaves, shifting pizzas, or retrieving a pan from a back corner of a hot oven — not to mention cleaning ash and grit so it stays out of your bread. It's all easier when the bricks are flush and flat. So it's worth being careful at this stage. If your bricks are used, clean them!

Your oven-mud subfloor should be quite firm and flat. Before I set the bricks, I spread a smooth, shallow bed of sand on the subfloor (the coarser the sand, the thicker the layer — so bricks won't wobble on a proud pebble). I may do a rough layout first, to see it's centered and if the tongue is where I want it. I also select the tightest fitting bricks for the center (writing or chipped surfaces face down). With the rough layout set, I mark a precise starting point — this can.be the center of the hearth floor, or one corner.

Then I'll remove the bricks and carefully re-set the first one to my mark. I hold the next brick level and about an inch above the surface; gently "kiss" its long side against the matching side of the previous one, and sliiiide it down 'til it's flat and lightly bedded.



"KISS" BRICK TO BRICK, THEN SLIIIIDE DOWN TO A FIRM LANDING



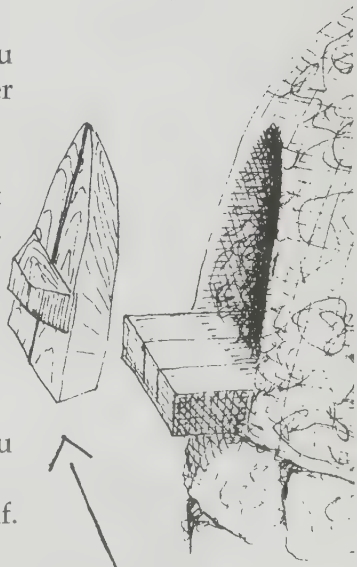
Once a brick is set, don't wiggle it! You don't want sand to work its way up the joints. Set each succeeding brick tight and even against the preceding one, with no gaps. When all the bricks are down, including the hearth "tongue," seat them firmly in their beds by tapping them with the handle end of a hammer. Each should be flush with its neighbors. If one stands up a bit proud, tap it down. If they don't all sit firm, flat, and tight, take 'em apart, re-do the bed, and try again. The second time is quicker and easier.

This is another good place to take a break, for an hour, a day, or a week, so things can dry out while you decide about a door, which is good to do before you make the sand form and start mixing oven mud. Or you can keep moving right along and not worry about the door 'til the oven's done.

STEP FOUR: CONSIDER A DOOR

The 10" *height* of your door opening is a critical 63% of your 16" dome. The explanation is covered fully on page 57. However, the door itself merely seals heat and steam inside the oven. If you don't get one made before your first bake, you can close a hot oven with an old plank, tin, bricks, or whatever comes to hand. Fill gaps with a wet rag, and it will work fine.

A simple wooden "plug" is also easy. Scraps of 2x4 or 2x6 work well. Arrange them so they're tall and wide enough, cut the shape of the doorway out of paper, trace it onto the wood, and cut out the pieces (angle the bottom, so the door leans into the oven on its own). Another scrap running perpendicular can join them, and be the handle.



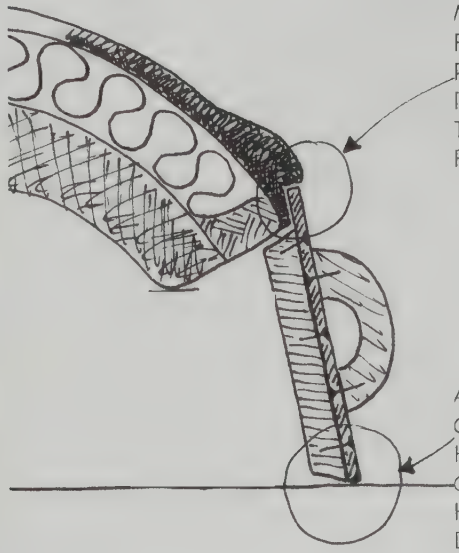
A SIMPLE TWO PIECE PLANK DOOR JOINED BY ITS HANDLE

If you build the door first, you avoid the template, and you can make the oven around the door itself. You can also start with an arch and/or a chimney, or add them later. More options follow:

A BRICK ARCH

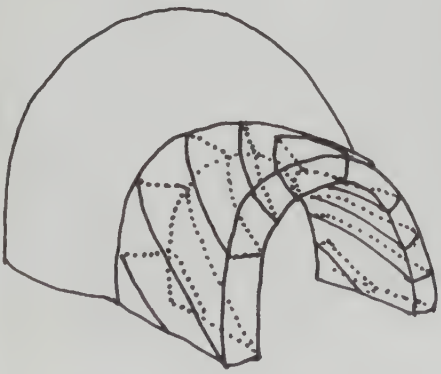
Note the extra tounge bricks supporting the base, and the pebbles wedging each arch brick into place.

DOOR OPTIONS



A TIGHTER, "FLANGED" DOOR

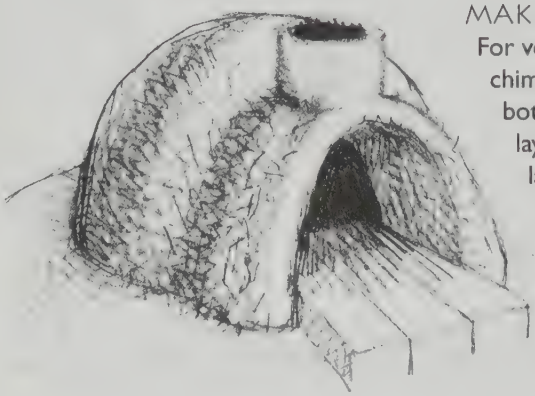
Cut a scrap of plywood to match the shape of the plug, but an inch higher and wider on either side. Fix a handle on one side, and then attach your "plug" on the other. When you're ready to plaster, set the door and adjust the opening so the flange seals well around the doorway; then plaster right up to the edge for a perfect fit. Sculpt a nice thick door surround for beauty and strength.



FRAME OR EXTEND THE DOORWAY

Make "straps" of long straw, oven mud, and enough extra building soil to make a stiff, sticky, rope of material that will bend without breaking. Use the straps to build an edge out from the doorway, extending it as far as your insulation is thick.

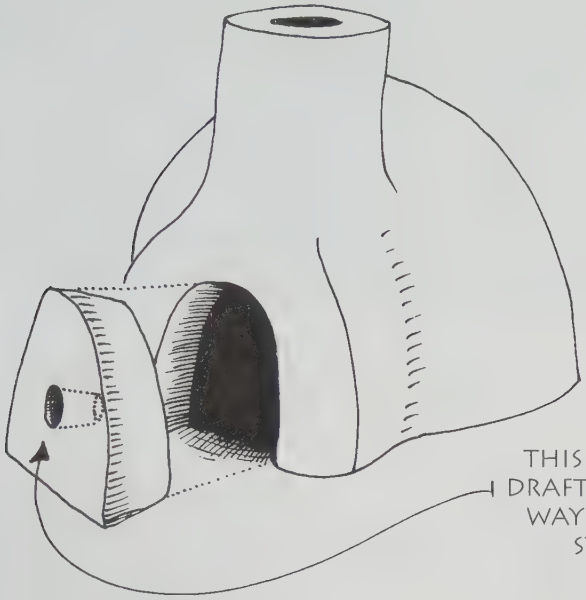
photos: B. Carlson, top, R. Dawson, bottom

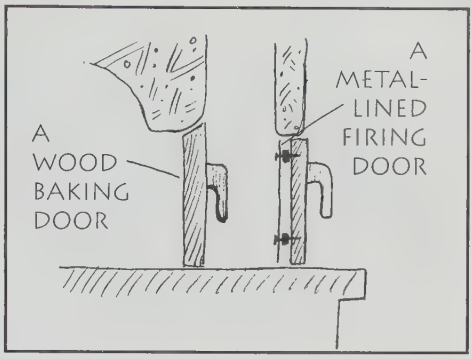


MAKE A MUD ARCH OF ANGLED LAYERS

For very thick insulation, or if you want a mud arch and chimney, make an angled wedge on either side of the bottom of the doorway (middle drawing). Work up layers of straps, keeping the edges neat, and extending layers to the center, until they meet over the top of the doorway. They will make a ledge that (when dry) can support a chimney. Or build around a piece of pipe and formwork as needed (photo, above). You may have to let the first straps stiffen up before adding the last ones. (The same principle is used in the middle east to make vaulted adobe roofs & domes.)

MORE DOOR OPTIONS

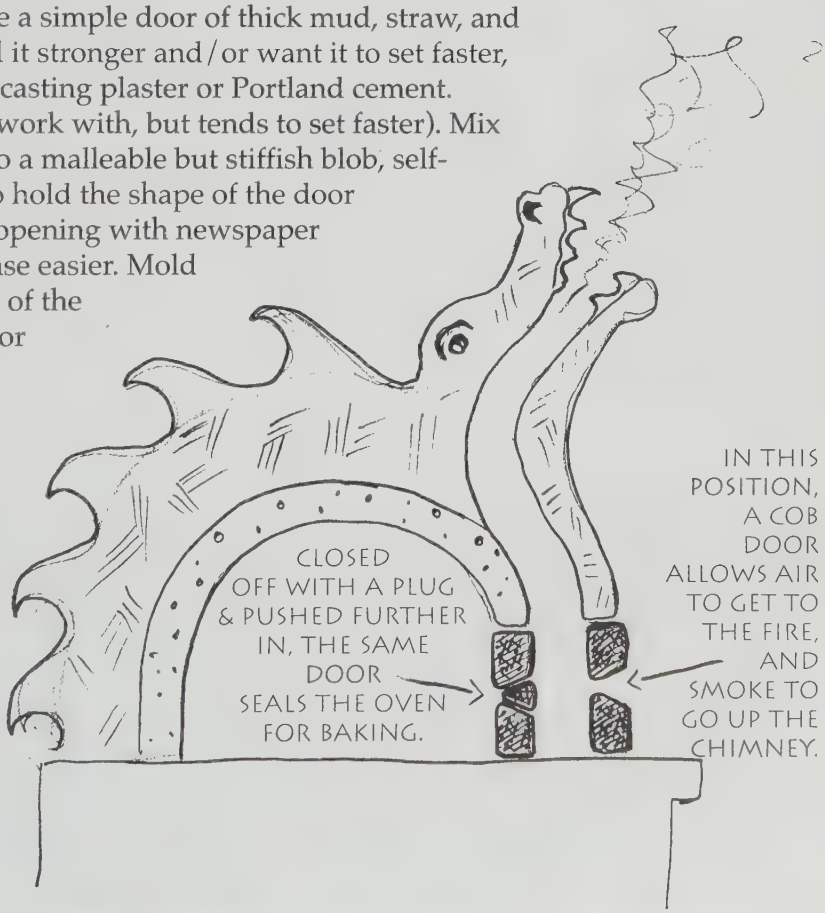




FOR A SIMPLE FIRING DOOR THAT'S IDEAL FOR OVENS *WITHOUT* CHIMNEYS, SEE PAGES 68-69

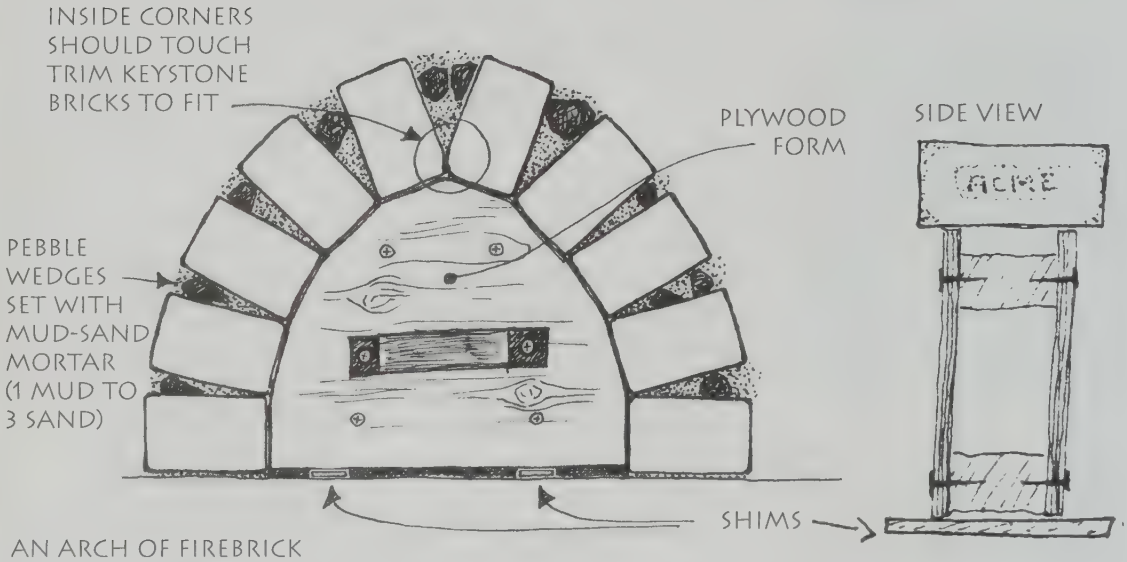
FIRING DOORS & DUAL-DUTY COB DOORS

You can also make a simple door of thick mud, straw, and sawdust (if you need it stronger and/or want it to set faster, add a bit of gypsum casting plaster or Portland cement. Gypsum is easier to work with, but tends to set faster). Mix them all together into a malleable but stiffish blob, self-supporting enough to hold the shape of the door opening. Lining the opening with newspaper will help things release easier. Mold the blob to the shape of the opening. Use a stick or fingers to make a generous handle. Let it dry until you can handle it easily. Put an extra layer of mud on the inside to protect the straw and sawdust from burning.



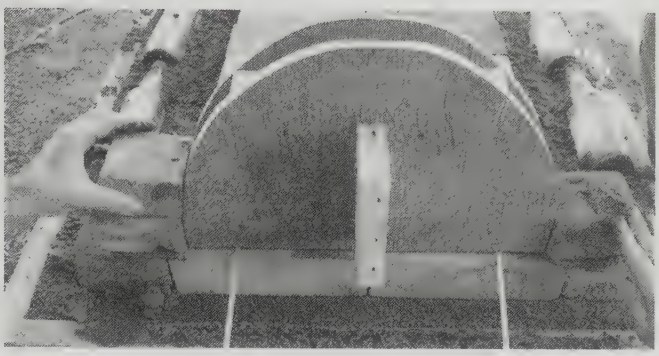
A FANCY BRICK ARCH OPTION

The opening is a vulnerable area of the oven. While mud edges will last if you're careful, they may suffer from banging, poking, production baking, careless kids, or, after a while, just normal usage. Or you may just want a more durable and "classic" arched brick opening. (Brick also makes a nice, flat, surface against which to set a metal firing door, which makes good combustion easier, especially on windy days.) Another option is a simple square arch too (see drawing and margin notes).



AN ARCH OF FIREBRICK
FOR A 22-1/2" DIAMETER OVEN: OPENING IS 10" HIGH X 12" WIDE

A round brick arch requires simple wooden formwork. I draw it out on paper first, arranging the bricks on end on the paper, like the drawing above. The bricks should touch at their corners for greatest strength. At the top center, depending on your brick size, you'll end up with one odd brick in the middle, or two bricks on either side. Either way is fine, as long as you end up with a wedge shaped "keystone" to lock the arch. Two bricks that meet at the center work together as a single key, as above. If you get a single brick in the center, adjust the angles of your other bricks and trim the inside corners of the center one so you end up with a wedge-shaped gap and a brick that fits. Without it, when everything heats up and spreads the arch, a flat-sided center brick could slip out.



ARCH MAKING: KEYSTONE & SHIM STICKS

Here a single keystone brick finishes the arch. The shim sticks (at right) are essential for removing the form. If you only have enough bricks for half an arch, split 'em for a half-width arch! The form can be converted to a well-fitting door. Improve it by filling the hollow space, and adding a flange.

When you get an arch you like, trace the inside line of brick faces on the paper, transfer the pattern, and cut your plywood. (The form should be shorter than your door height by the height of the shims it will rest on — or you'll need to remember to raise the first bricks on a bed of mortar.) Fix the two pieces on either side of your 2x4 core. Remember to keep the left and right sides of the plywood matched.

Find or cut two thin slips of wood, 1/4" thick and about a foot long, perhaps with a very slight taper (chopsticks work nicely). Set your form on those shims and on your hearth bricks where the door will be. It should sit firm, solid, and plumb. The shims should stick out far enough that you can pull on them later.

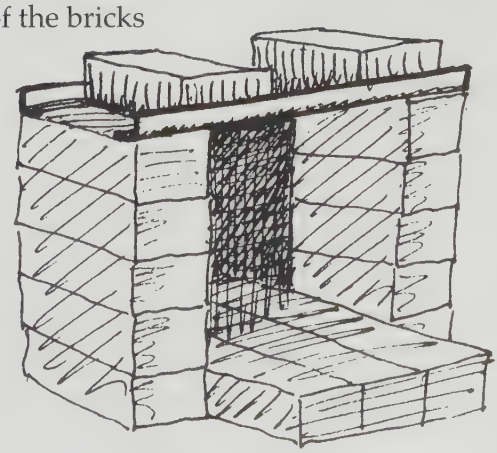
Put the bricks back around the arch form on a thin bed of mortar. I use small stones to hold each following brick at the right angle. With one hand, hold the brick against the form; with the other, wedge a pebble or stone chip into the gap so that it holds the brick at the proper angle. Work both sides to the middle, remembering that the inner edges of the bricks should touch.

When you're happy and keystone is tight, ease the shims out. The form should drop so you can wiggle it out. Assuming it all works, either put the form back, or take it all apart and re-build it. The formwork will hold back the sand form.

Fill the gaps with a bit of mud mortar. Be firm, but don't push hard enough to dislodge wedge pebbles or brick. Finish ("strike") the joints with the back of a spoon.

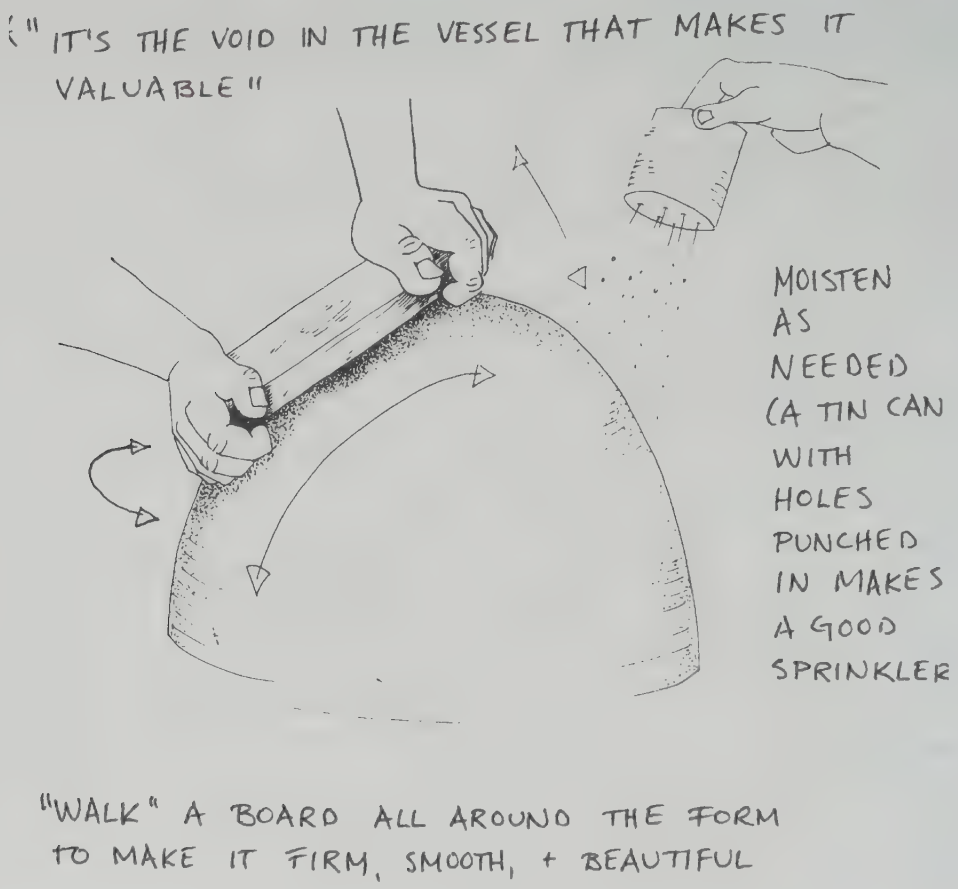
AN EASY-TO-MAKE "FLAT" ARCH

Angle iron or other metal supports between columns of stacked bricks — no mortar needed, and if you're building a chimney, just leave out the middle brick.



STEP FIVE: MAKE A SAND FORM, OR SHAPE THE VOID*

The oven is a void, and the sand form is what shapes it. Cover the void with oven-mud, dig it out — there's an oven!



Allow enough time to make the sand form and cover it with the first layer of oven-mud all at once. You want to avoid a "cold joint" in the mud layer that might invite future cracking. Even a 27 or 36 inch oven is easily do-able in a half day, especially with a bit of help.

Draw out the circle of the oven in a smooth line all the way to the very edges of your hearth bricks. The line should evenly contain a maximum surface area. (A string tied to a pencil makes a compass — hold the string end at the center, and swing an arc with the pencil.)

Start piling moist sand out to the mark. The sand should be damp, but not so wet that it slumps. You can go up in layers or

build out from a central pile, but keep the walls near vertical at first, so as to maximize the usable space in your oven. (Imagine a hemisphere sitting on a 4" disk.)

The form should reach all the way out to the very edges of the bricks. (If you're making a brick arch, work gently against the form so as not to dislodge anything. Brick ends will be partially buried in and secured by the walls of the oven. Keep the edge defined where sand meets bricks — use a spatula, thin board, or mason's trowel.) Tamp sand firmly as you go.

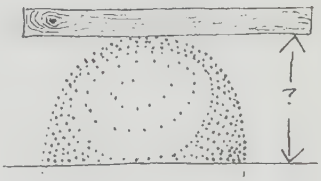
Typical dome height is 16." Much higher, and you may get cooling eddies at the top of the dome; additional volume will also reduce the concentration of beneficial steam in your oven. A very low dome may compromise how it burns, though pizza ovens are often lower. I wouldn't go much lower than 12 inches (if you do, remember to adjust your door height). Make it beautiful. Good shape makes a good fire. Imagine flames "roiling in the void."If you can, make the highpoint at the far end, and taper it down to the door (natural and easy with an oval oven, which looks like a halved egg on it's side).

A nice trick for monitoring dome height is to cut a 16" twig or stick to insert into your half-built form. When you reach the top you're there! Or hold a straight stick across the top and measure to the ground.

The finished dome should be even, hard packed, and solid. To ease removal of the sand, cover it with a sheet of wet newspaper. Make thin strips if big sheets are too hard to work with. Or use big leaves. Smooth them down flat so that edges won't get caught in the mud and make a crack.

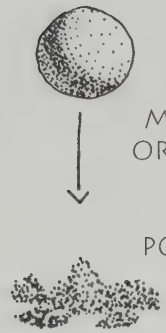
SLUMPING SAND! & OTHER FORMS

Water both glues and lubricates sand: too little and it won't stick; too much and it slides. (Grain size and shape also matters; see p. 32.) To dry out a pile of wet sand, let it drain and scoop off the top. I've also stabilized a form by stacking chunks of wood, bricks, etc., to support a thinner layer of sand (keep pieces small for easy removal, and separate them with shims or a layer of sand for "wiggle room" on the way out). If your sand is coarse and lacks "fines," you can add clay — just a little, and on the dry side. Adjust 'til it works. You can also make a form of topsoil, or straw tied with twine (burn it out!). The Canadians bent, wove, and tied saplings into a basket form (I've seen the same done with bamboo). One reader tried a cardboard packing tube (waterproof it so it won't go mushy). On page 103, there's a an oven built over a beautiful basket made of woven willow withies.



TYPICAL DOME HEIGHT IS 16"

STEP SIX: FIRST LAYER: DENSE "OVEN MUD" FOR THERMAL MASS



THE RECIPE:

1. One part building soil
2. Two to four parts coarse concrete or "sharp" sand.
3. Water

Sometimes you'll find what cobbers call "redi-mix," a perfect combination of sand and clay that just needs water. But I find that most soils requires some amendment. I'll use two parts sand if the soil seems silty; four parts sand only if the clay is very pure. When in doubt, I'd rather have more clay. Mixes vary. Most of them work. When in doubt, try your tests again.

Add just enough water to make a firm dough. If your building soil is already quite wet, you might not need any. Texture should be homogenous throughout, with clay and sand thoroughly blended. A hard packed ball shouldn't shatter when dropped from shoulder height. (Pat the ball firmly 50-100 times to consolidate it. This is actually a bit of a trick, and worth trying several times before you decide about your mix.) If it does shatter, it needs more water or more mixing. If you add water and it still shatters, it might need more clay. If it flattens into a smooth pancake, it's too wet.

MAKE LESS WORK

If you find that your material is perfect right out of the ground, great. But if you have very dry or partially dry material, or stuff that's in large hard chunks, or stuff that's full of rocks, you may be wondering, "how am I going to ever get this mixed into the sand?"

A few things can make it easier:

- Completely dry building soil, when you soak it with water, will go beautifully soft overnight or quicker. If it's slightly moist, however, it resists infiltration by water (one of the marvels of clay that makes it good for lining ponds and making dams). I take a bucket half full of water, add dry soil until it's full, and wait for it to soften. I pour off excess water before using it.

- If you have somewhat moist material and/or little time, it can help to let it soak anyway. When your time runs out, you can either mash it up by hand and foot, or you can apply technology, and make a "bucket blender" with a heavy duty mixer on a heavy duty drill (see p. 41).
- It's pretty easy to screen out rocks, either on a heavy duty metal screen ("diamond mesh" is good), or a wooden frame covered with heavy wire cloth. 1/2" mesh is OK, tho 1/4" is nice if your soil goes through relatively easily. If your soil is too sticky and chunky to go through the screen dry, you may need to soak and mix it, screen it wet, and even let it dry some before using.

MAKE A MIX

A tarp makes room for group fun. Pour the sand in a circle around the center of the tarp, so it's like a donut. Dump the building soil in the center, add water if you need to, and jump in feet first!

Barefoot is best, in my book, but if you think there's *any* chance of finding glass or nails in your soil, or just sharp stones — then boots are good. Mash up the material until it's smooth and sticky. Pull in only enough sand to aid in breaking it down. As you twist and turn, your feet work like rotating pistons, breaking up the clay and pressing sand into it. But don't be serious! Play music! Grab a partner! Dance until each grain is well coated with a layer of stickum.

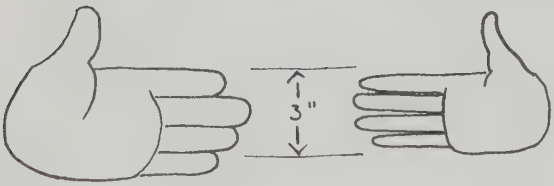
Keep pulling in more sand until the mix is homogenous, and dance some more! It can help to spread it all out thin — a couple of inches or so — to make sure the little bits of clayey stuff are pulverized. Any added water should just soften the mix to workability (if it's not already there),

The tarp makes it easy to fold in the heavy stuff: stand in the center, bend over, grab an edge, and pull *back* towards yourself. Stop before the mud rolls off the edge. Two or three together can develop real rhythm and speed. I also find it easiest to mix all my material at the start, so I can concentrate on building. (A typical mix is about 3-6 buckets-full.)

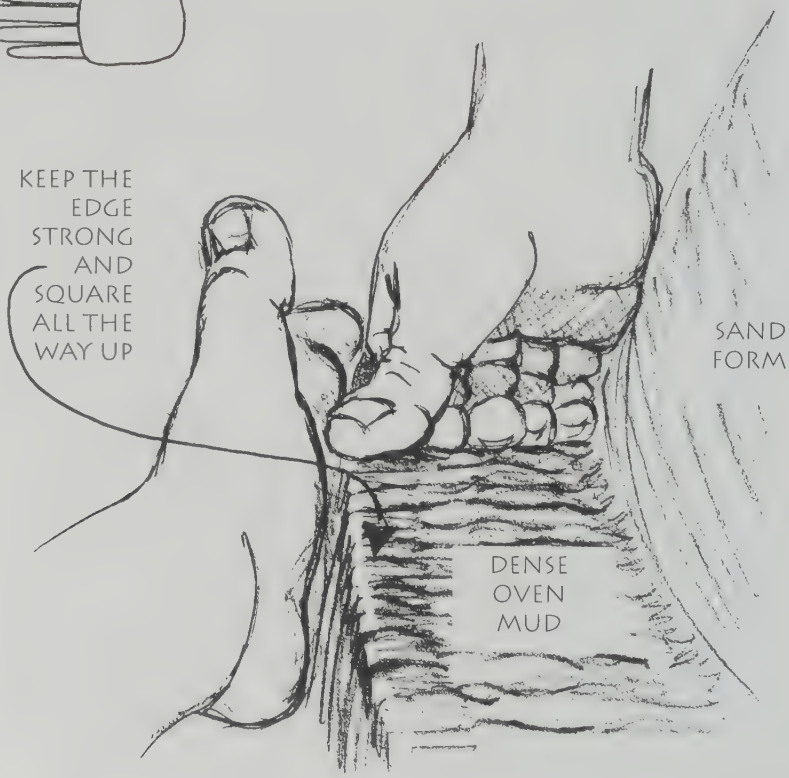
CAN I JUST USE PURE BUILDING SOIL & NO SAND?
Yes! For more discussion of the pros-and cons, see page 103.

EASIER MIXES

It's much easier to make a wet mix than a dry one, but it's easier to build an oven with a dry mix. So make your mix wet and let it dry out to a good consistency. Store it under cover (but not too long!) If you build it wet, allow more time for the oven to dry before you go on to the next layer. If "necessity is the mother of invention," maybe laziness is her father.



USE YOUR HANDS FOR A STANDARD MEASURE



MANY HANDFULS MAKE A LAYER

When your mix is ready, press handfuls around the base of your oven, remembering that the mud is what will hold the hearth bricks in place. As you work up over the bricks, press the mix down with thumbs and fingers (rather than in) so you don't damage your sand form. Press the mix into itself, as if the form wasn't there. This will not only maintain the form's integrity, but also insure that each handful of mix is well integrated with the rest.

This layer will be 4 inches thick (thinner for a pure pizza oven; thicker for a serious bread and baking oven and longer hours of heat. Remember, though, that more mass means more fuel.)

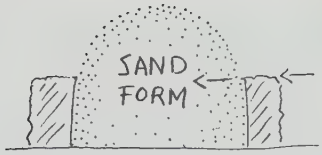
Use your fingers to help you maintain an even thickness. Four inches on my hand is "four fingers plus a bit" — a handy guide (pun intended) and adjustable!

Use small amounts of material, and take care not to leave voids or soft spots where the mix meets the sand form. Use one hand as formwork to maintain a well-defined edge, and press the mud against it with the other hand. Don't slap or pat, as that makes it go soft.

If you're making the brick arch, be especially careful at the thin spot where the sandform meets the brickwork; use a single finger or a stick to pack the mud into the tight places.

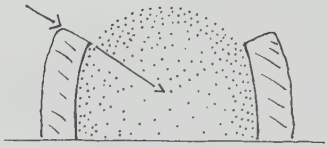
Keep going until you've covered the whole form. Keep in mind, too, that it is sculpture — stand back and notice the shape: is it good? Are there low spots? High spots? Flat spots? Use a board about a foot or two long to blend all the lumps and planes together into smooth, deliberate curves. Work the larger shape until it looks natural, like a ball or an egg.

Now take a flat board, scrap of 2x4, or what-have-you, and consolidate the material, whacking it firmly with the board. It should go hard and smooth, and sound solid. If it squishes out from under and/or it sticks to the board, your mix was a bit too damp — but don't worry! Instead of whacking, rock the board firmly back and forth, up and down, the same way you did on your sand form. Or try rubbing it in small circles. The mud should be beautiful and firm. If it's way too wet, the more you work it, the more it will slump. Stop! Let it dry out and try again later.

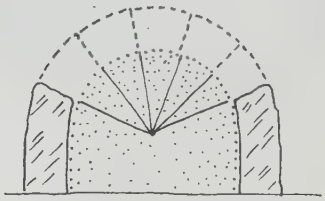


ONE

As you go higher, the face of the layer should angle upwards

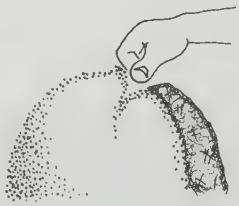


TWO

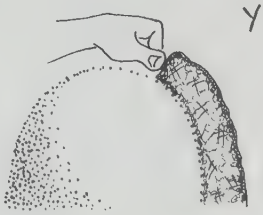


THREE

MAINTAIN THE INTEGRITY OF YOUR SAND FORM



NO



YES!

PRESS MUD AGAINST ITSELF, NOT AGAINST THE SAND FORM

DRYING TIME
this oven was completely finished before we emptied out the sand, so it took quite a bit of time before both oven mud and insulation were dry. We did hurry it up a bit with a fire (below).

REMOVE THE SAND FORM

How do you know when it's time to empty out the sand? The mud should be stiff enough (on the inside, near the sand form) that you can only just dent it with your finger. Depending on your mix, this may be immediately on finishing the first layer, or days later. When in doubt, wait! Rushed ovens can collapse, especially if the dome is a bit flat, or the oven very big. (But don't worry! The second time is easier — and faster.)

Use your hands as much as possible to remove the sand, since you may not notice when a stick or other tool starts chipping away at the inside layer of your oven. As you dig out the bottom, sand will fall on its own. Long arms, a tool, and a flashlight may help for the far reaches. Peel away the newspaper. If you find rough or loose spots inside, try polishing and compacting them with the back of a spoon.

If you like, this is another good place to take a break. Each layer will dry faster individually than they all will together. (The oven will also dry much faster with sand removed.) And you need not worry about bonding layers one to the other, as they each function independently, and are individually supported by their dome shape.

And that's really it for the basic oven! Once the sand is out and the oven is dry, you can start baking. If that appeals to you, go on to the chapter on firing and baking. After you've baked a few times, you'll be able to test exactly how much difference insulation can make.

LIGHT A DRYING FIRE
Start at the front, and keep it small. When it's going well, push it back.. It should have enough room to burn bright and lively.

STEP SEVEN: OPEN THE DOORWAY

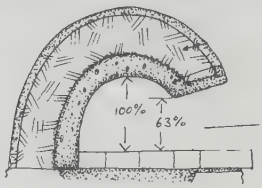
SIMPLEST HAND-CUT OPENING:

Use a big spoon or other implement to make a line and cut through the moist mix.

Door height should be 63% of the height of your sand form; my standard form is 16", so my standard door is 10" (0.63 x 16 = 10); width is typically half the oven diameter (11.5").

The cut should angle in, like the lid of a jack-o-lantern. This makes the inside of the cut lower than the outside; measure your height from the *low* point.

After you've neatly trimmed the cut, round off or "ease" the edges with your spoon or other tool, compacting and polishing the mud to make it all smooth and strong.



WHY 63%?
In their classic book, *The Bread Ovens of Quebec*, researchers Boily and Blanchette examined hundreds of Canadian clay ovens and found that the average door height in the best ovens was consistently 63% of the height of the sand form. Inferior ovens compensated for high or badly formed domes with rear vents to aid draft & combustion.

STEP EIGHT: LAYER TWO — INSULATION

The insulation layer is simply a four inch thick shell of sawdust-clay mix over the top of your dense oven mud.

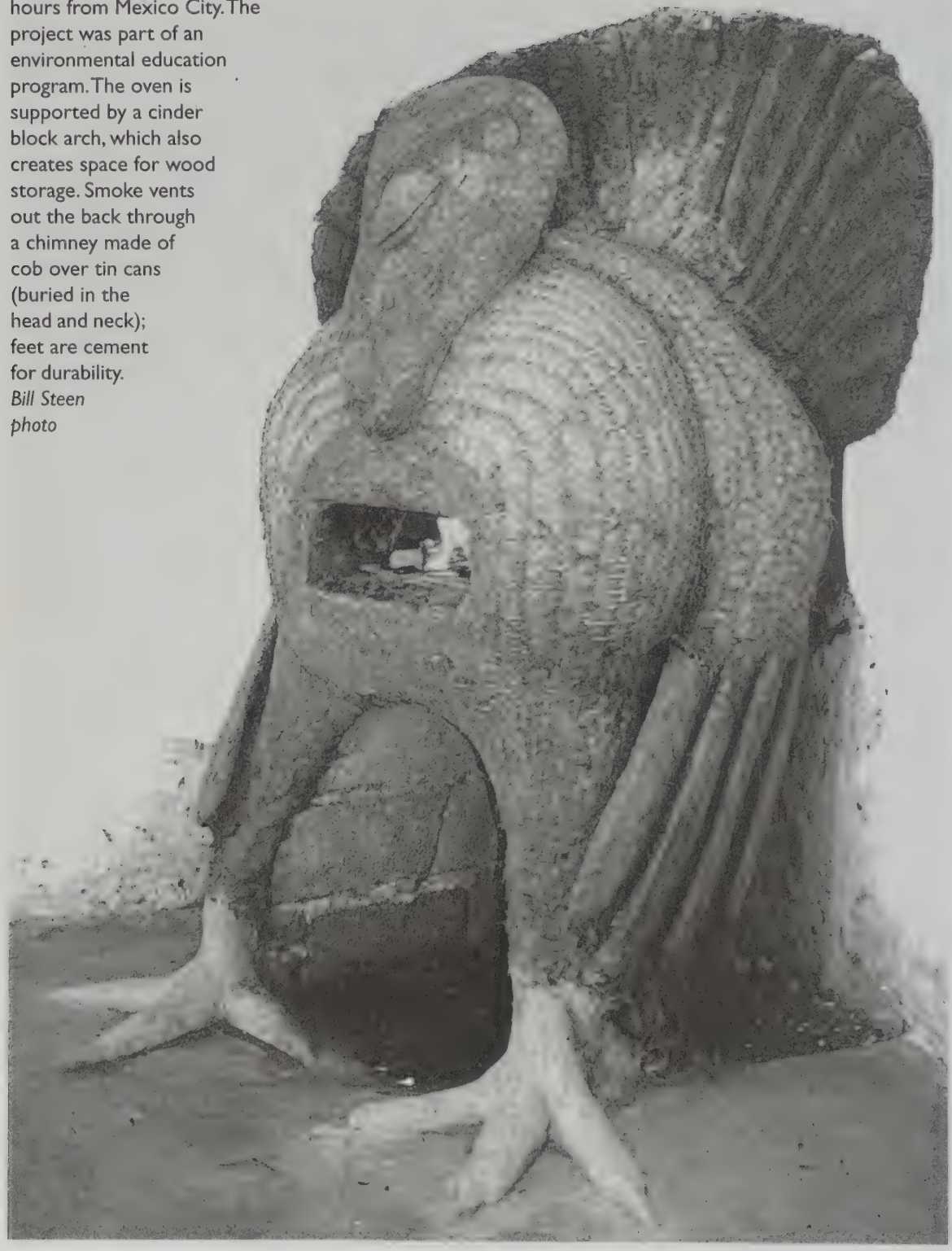
Assuming you're not using a brick arch, it's good to frame or extend the doorway first (see page 46). Then mix up the insulation as you did the sub-floor insulation (see pp. 41-42).

Cover the whole oven the way you did with the oven mud. This is fairly fast, as the insulation packs easily and you don't have to worry about consolidating it so well as the dense layer. After all, the point is to create air pockets.

When you're satisfied with both thickness and shape of the insulation, you can either let it dry, or continue on. The final step is finishing, which has a chapter of its own.

WARNING: If you're using fine sawdust, you might want to dry out your first layer before insulating. Fine sawdust holds more water, which can percolate down into the dense oven mud, softening it and raising the risk of collapse!

GUAJOLOTE (TURKEY) OVEN, ATLANGA, MEXICO, 1996.
Fifty children helped build this oven in a community center three hours from Mexico City. The project was part of an environmental education program. The oven is supported by a cinder block arch, which also creates space for wood storage. Smoke vents out the back through a chimney made of cob over tin cans (buried in the head and neck); feet are cement for durability.
Bill Steen photo



CHAPTER THREE: STRUCTURAL COB & OTHER SCULPTURE

KIDS MAKE MODELS FOR AN ARDILLA (SQUIRREL) OVEN, TLAXCO, MEXICO, 1997.
If you can make cob with your mud, it will probably serve as pretty good modeling clay too; good for working out ideas and forms.

GOOD SHAPE

Everyday, the shapes of life work on us: plants, animals, spoons, cups, bowls, the bodies and buildings we inhabit, the food we eat...It's all sculpture.

Well plastered and finished, your oven will look beautiful and egg-like. The insulation layer is typically pretty rough, but depending on how much you work it, you may have something that already looks done. But a layer of finish plaster will provide a harder, more durable surface, as well as a "canvas," of sorts, for decoration and sculpture.

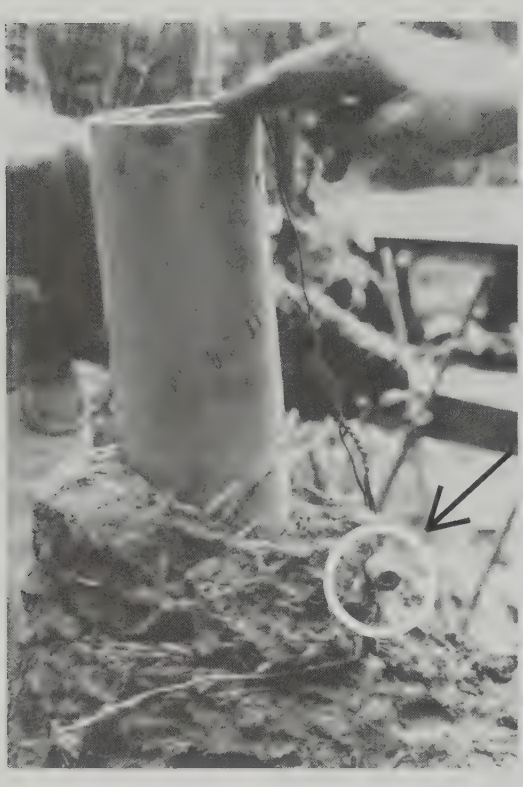
If you're inspired to make more involved and complex sculpture, try making models of cob or pure clay, to see what pleases you and to work out your ideas in three dimensions. Or build up rough forms directly on the oven to see if you like the new shape(s).

If you need to sculpt limbs or other elements coming off the main shape, you'll need to build up larger masses of self-supporting material. There are limits to what you can do with wet mud — so reinforcement can help.

SCULPTURAL/STRUCTURAL COB

Straw greatly increases the wet strength of cob, so you can shape and mold it into limbs and protrusions that will hold themselves in place while they dry.

Adding straw also means you can make much wetter mud than your first layer of dense stuff. How much water depends on how much straw you want to add, but in general, the mud can range from stiff peanut butter to yogurt consistency. If you experiment, you'll discover that more water and more straw actually makes a mix that will support more of its own weight when wet, which increases sculptural possibilities. You'll probably find that it's best to start with mud no stiffer than peanut butter, add as much straw as you think you need, and experiment. All this, of course, is still done on a tarp. You can start by further wetting leftover oven mud!



DEADMAN & STRING HOLD WET MUD: The wire is attached to scrap wood buried in cob; at the other end, it holds the tube from tipping with the weight of the mud. As we built up the chimney, we used string to further secure the wet cob. Once dry, it was fine. *(N. Waddoups, photos)*

Less water and less straw gives you a softer mix that "splooges," or spreads under its own weight, severely limiting what you can do before you have to stop and let things dry. This can also be nice if you prefer subtractive methods; nearly dry, it carves reasonably well with no more than a straight clawed framing hammer, hatchet, old meat cleaver, or machete.

RECIPE: TRADITIONAL "COB" OR SCULPTURAL/STRUCTURAL MUD

Add to your basic mud recipe:

- Water: generally, you want to add the water before the straw; this makes it much easier to mix in. How much water you add will determine, in part, how much straw you can work in. With experience, you'll gain a feel for what works and what you need. You can also make custom mixes by the handful, adjusting proportions as you go, to suit the application.
- Straw (for flexible strength, like re-bar in concrete or fiber in fiberglas). After the grain has been harvested, there's nothing left but tough, woody stuff. The longer and tougher, the better it will hold everything together, especially when wet. Hay, on the other hand, is cut before it makes seeds, so there's still food in the stem. Bacteria and other bugs like to eat it, so it's not great in cob.

SOME TRICKS

You can make thin, strong structural elements out of "straw wattle," which is long straw combined with thick pasty mud (the consistency of mayonnaise or warm butter). Dip handfuls of straw in the mud, and work it into a rope. Or schmear mud on a flat surface, sprinkle with straw, and roll it up.

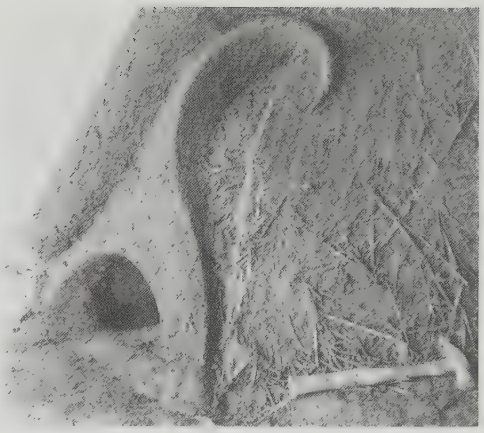
To anchor elements that protrude or lean precariously, embed chunks of wood as "deadmen." First, attach a piece of natural fiber string or wire to the wood. Secure the piece under heavy cob. Use the string to secure limbs, or as an armature for tying on straw wattle "straps." They dry strong, relatively light and very slowly. You can also use cloth or sticks in a similar way, or use your imagination in new ways!

Straw can make unfinished cob look like a furry beast. Detail can be next to impossible, so start by carving it a bit smoother — easier when it's dried a bit.

Stand back! You can't make sense of the whole unless you can see it, and you can't see it if you're 12 inches away. Keep things in perspective by constantly changing your point of view.

Every shape is made of flat planes. Curved planes are just many small flat planes smoothed together. Establish large planes with a flat board, or trowel, or with a knife. As you work, you'll see how the planes are connected.

The right tools will help you define and refine shapes and sculptural lines. Machetes, hand-axes, spoons and knives are high on my list, but try whatever you have: kitchen utensils, masonry trowels, sticks, stones, etc. Small sticks with cut or broken ends can make wonderful surface patterns and texture, and you can also inlay things into the mud itself: bits of tile, wood, stone, glass, ceramic, what-have-you (this is best done in finish plaster, however…).

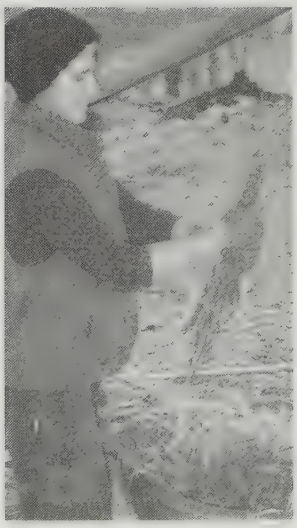


SCULPTING WITH STRAW WATTLE: Straw wattle can be used to achieve an excellent level of detail., despite how fuzzy and rough it might seem when you're making straps. It helps to get the mud mix just right. And it takes a *long* time to dry! *Tara Johnston, photos & sculpture (see color section for photos of the finished work)*

FINISH MUD, OR PLASTER

As you define the form, you'll want a finer grade of material for detail. This "plaster" is made with shorter straw and perhaps finer sand. The term is generic, and applies to everything from real, under-your-feet mud, to gypsum plaster (also called "Plaster of Paris," or "casting plaster"), to stucco (the old-fashioned kind made of lime and sand, or the post WWII kind made with cement), to traditional African mixes of manure and clay. Any mud can be "plaster," and most plasterers call their material "mud."

In addition to finer sand and fiber, plaster may have a higher proportion of sand to limit cracking. It sticks well to most surfaces, sometimes thanks to the addition of various gluey binders. It will also stick better to a textured surface, especially if you need to apply a thicker, heavier plaster.



TESTING PLASTER

About two buckets of mud should cover a 22.5" oven with a full inch of plaster. If you have left over oven mud, you could just add water & fiber and go — but test it first. Schmear some on a board or section of wall, as thick as you intend to use it on the oven, and let it dry. Cracking means it needs sand; if it's soft or crumbly, add building soil/clay.

A GENERAL PLASTER RECIPE

1. One part building soil (screened, if you want a finer mix).
2. Three to four parts sharp mason's sand or concrete sand (also screened as needed).
3. Just enough water (too much causes slumping/cracking).
4. One half part (more or less) fine fiber (short stuff (1/4" or less) is best for detail work and/or thin plasters).
5. Optional: a dollop of wheat paste binder (see sidebar).

MIXING PLASTER

Use the ratios from your building mix as a guide. Otherwise, the basics are the same, but wetter and faster. If you're using dry fiber, like chopped straw, add it last, fold, stomp, and add more water as needed. If you're using wet fiber, you can add it to the clay at the start.

AFRICAN PLASTERS

In south Africa, plaster made of pure manure and clay is called "Dagga." (see *African Painted Houses*, Van Wyk, in Resources). It is lovely to work with and is impressively tough and water resistant. It is not waterproof (nor would you want it to be) but it may limit water absorption. If you find colored clay, dagga can be a vehicle for applying it in decorative ways. Or you can just mix the manure into a regular sand-clay plaster. For that kind of application, I usually use about half as much manure as building soil.

KINDS OF FIBER

- **Manure:** should be from grass-fed animals; it will smell strong, but not offensive. Ask a friendly farmer for pasture access. Fresh is better than old and dry (live enzymes make livelier plaster). Cows (with their many stomachs) produce finer stuff than horses. Sheep, goat, rabbit, or deer manure might work too. Composted, bagged manure is no good, as bacteria will have digested the fibers. If you're worried about disease, or squeamish, use rubber gloves or:
- **Chopped straw:** easiest to sweep the floor of a barn, but a machete works — be careful! Or use a string-type weed-whacker in a big garbage can (do it on a tarp to catch the bits), or a leaf/yard waste shredder. For a finer material, sift it through a screen (1/8" — 1/2").
- **Cattail or other fibrous fluff:** try to harvest when it's loose and comes off the stem easily; you may find it easier to mix it with your water before you add the water to the mud.
- **Miscellany:** soaked, whipped newspaper is short, weak, and not so nice as manure; horsehair is good, but you need the short body hair, finely chopped bits of sisal twine also work. Maybe dryer lint? Try it and see!

I usually make my plaster a bit wetter than peanut butter, and adjust according to the application. It's easier to add water than take it away! To dry out a wet mix means spreading it on a tarp and waiting, or adding dry sand and more building soil — heavy and time-consuming!

TIPS FOR DECORATIVE APPLICATION

Plastering is pure pleasure, like icing a cake or finger-painting. Prepping the surface by scratching it and wetting it will help plaster stick better. Use trowels or just schmear it on by hand. Sometimes it goes easier if you schmear it just once, not again and again.

Thickness can vary from a sixteenth of an inch to an inch or two or more. Thicker is trickier, as heavy mud may sag, crack, or fall off — unless you give it more texture to "grab" onto — deeper scratching, or some sort of lath, from little sticks hammered into existing mud, to coarse burlap glued and pegged on, or baling twine randomly wrapped and tied off.

Smooth the plaster with circular strokes of your hand or other tool. Every tool gives a different effect: wood gives subtle texture, metal a harder polish. Hands alone make beautiful textures, everything from deep finger and hand-prints, to subtly undulating surfaces.

For a hard "polished" finish, wait 'til the mud is stiff, like leather, but still dark with moisture (if you're not sure, test it). Use a hand-sized scrap of smooth hardwood, stone, or the back of a spoon, and rub it in small circles.

In general, texture adds vitality and depth (especially when colored), and increases visual impact. Scratch designs into the surface with a fork. Press the bowl of a spoon into it and see what it looks like. Try the end of a stick. Fingers work different than fingernails, soft plastic is different than hard, etc. A brush dragged over a wet surface makes a lovely texture that will vary with the stiffness of the bristles and the wetness of the mud. Try a whisk broom or a comb. See what the light does when you drag it one way and then the other. Make patterns. Invite the other kids to come and play.

A NICE COLLECTION OF QUALITY SCULPTING TOOLS

WHEAT PASTE FOR SMOOTHER, TOUGHER FINISHES

Wheat paste can make your plaster both stickier and smoother. I add it as needed, and go by feel more than exact measure. Make wheat paste from a thin batter of flour and cold water (no lumps!); add it to boiling water, stirring constantly 'til you have thick glue. A cup or two makes a wheel-barrow-full of plaster go from sandy and loose to "fatty" and cohesive (much less if you use the dry powdered product that you can find at some paint/wallpaper stores — I avoid the synthetic vinyl stuff). See Resources for more info on other binders.

LIME PLASTER & OTHER WATER-RESISTANT, BREATHABLE PLASTERS

Lime plasters are traditional around the world, especially with earth masonry. They make a tough, water-resistant surface and take color beautifully, but are tricky to do well.

Traditional "lime putty" is hard to find, but dry, bagged mason's or "hydrated" lime works (see sidebar). Basic lime plasters are made of 3-4 parts sand to one part lime, and *just* enough water to make it workable. Aging makes it better, as does fiber — to hold everything together. Horsehair is traditional, but straw or manure work too.

Michelangelo's Sistine ceiling and Diego Rivera's murals were painted on fresh lime plaster (thus "fresco"), and their pigments were made from various soils and ground rock mixed with a bit of lime-water (off the top of a bucket of lime-putty, or lots of water with a tiny bit of lime putty in it).

MASON'S VS AG LIME

Agricultural lime, used for "sweetening" acid soil will NOT substitute for mason's lime, which is stocked by masonry & some farm suppliers.

The lime cycle begins when limestone is heated over 1500° F, to become quicklime. Add it to water (called "slaking"), and you get heat and hydrated lime. Exposed again to air, you get limestone. Mason's lime has a limited shelf life, unless mixed with water to make "lime putty," and kept wet.

CAUTION: Mason's lime is caustic, and slaking quicklime can be dangerous; please do your homework, and be careful (see resources).

In chemical terms, the cycle goes like this:

$(CaCO_3)$ + heat - (CO_2) = (CaO)

+ (H_2O) - heat = $(Ca(OH)_2)$

- (H_2O) + (CO_2) = $(CaCO_3)$

COLOR

I collect colored earth when I see it. Commonly in western Oregon, I can find yellow, orange, red, brown, and black. Less common are white, (greyish) blues, greens, and even purple! However, concrete pigments also work well (Davis colors, for example). Many are various forms of iron oxides, quite potent in small amounts, and relatively cheap at the builder's supply.

Colors can be mixed into the plaster itself or applied on the surface of the finished plaster. Mixed with water, or a binder (wallpaper paste, waterglass, casein (milk protein), etc.) you get home-made paint (see *Natural Plasters* & *The Hand Sculpted House,* in Resources). Or try the ancient cave technique of blowing dry powder onto the wall itself. The most basic "whitewash" is just lime and water; you can add pigment to make colored washes.

IMPORTANT SAFETY NOTE: If you want a full range of pigments, be very careful. Some blues, yellows, and greens (especially those used by potters for glazes), can be *highly* toxic; some contain heavy metals and pose hazards even just with skin contact. Ask for "MSDS" info, or "Material Safety Data Sheets." And any powder can be hazardous to the lungs. Avoid breathing the dust.

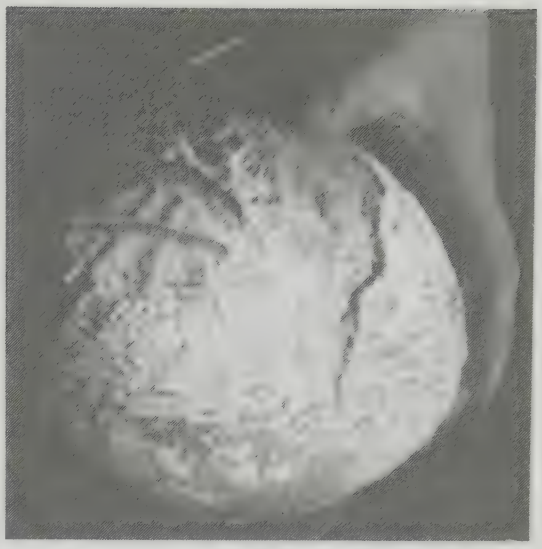
LIME-PLASTERED FALCON
Built by the author as a community oven for an apartment complex on the Oregon coast, where peregrin falcons sometimes make their homes. The finish is a lime plaster, tinted, fresco-style, with various oxides of iron — mostly concrete pigments (see photos in the color section). The shelter is made of portland cement on a rebar and chicken wire armature. The ash dump empties into the bucket between the birds' legs.

"FROBEARILLA," OREGON, 1999
Built by 6 young men and the author, as part of a "arts-in-education" project in a foster home. They also worked with a writer to record and reflect on their experience in prose and verse.

CHAPTER FOUR: USING YOUR OVEN

PRACTICE

You will learn best how to use your oven by using it. Experience hones your senses, senses hone your skills, and experience plus good sense = knowledge. This chapter covers the basics of firing and baking in your oven; chapter six explains (and encourages you to apply) basic theories of good oven practice.



BREAD & FROG
Above, Hannah holds a loaf from our home oven.

Opposite: an oven built by the author and workshop participants in a Portland, OR garden. A pole structure and roof came later. After the workshop, the owners wrote: *Kiko — Roasted sweet potatoes, zucchini & onions in a cumin/orange juice glaze, with roast garlic pork loin (for the meat eater) and baked apples, then roasted eggplant, squash and leeks, rosemary polenta, herb roasted salmon and peach pie. This morning, cinnamon rolls....* *(Nani Waddoups, photo at left)*

1. "OVEN WOOD" IS THE BEST FUEL

In the old days, ovens were heated with "faggots" of small twigs and brush gathered into bundles. At our house, "oven wood" ranges from old tomato stakes, scrap lumber, and prunings, to branches too big for the stove. Softwood or hardwood is fine; but denser wood has more heat in it. Small is best! Keep a splitting axe near the oven.

Look for tree or yard prunings from landscape or city maintenance crews, or a local orchard: ask if you can haul it away before they run it through their chipper. Prune your own trees. Green wood needs to air dry several months at least; or quick dry it in a warm (not hot) oven.

Cabinet- and furniture-makers often discard or sell their scraps. Shipping pallets are good. Building contractors pay to dump huge containers of "waste" wood in already over-full landfills. Avoid stuff that's treated, painted and possibly toxic.

2. DRY YOUR FUEL

If your fuel is wet, it will produce steam that will cool and stall the fire. Seasoned (*not* "green") wood holds 12-20% moisture; kiln dried wood retains about 6%. If ten pounds of good firewood holds two pounds of water (a quart), that's a bit like trying to keep a fire going in the rain.... Your oven, however, can make an excellent kiln for driving out 50-75% of the moisture in your fuel. For a small effort, you can reduce fuel consumption, and heat your oven quicker. When the oven has cooled below about 250 degrees, fill it with wood for your next fire. (Drying it hotter can be dangerous, especially if the oven is used daily and stays above 200°F. Volatiles driven out of the wood can condense in the insulation and be re-ignited, posing a great risk to any nearby flammables.)

Recently, I decided to monitor my fuel consumption. Using just small, dry sticks, I cut firing times by a third, and fuel consumption by about half. For our 23x32 inch oven, a typical fuel load is now less than an oven full (see photo page 19). On a recent firing with some good hard wood, the oven burnt clean in 40 minutes — but we generally let it go for two hours and sometimes a bit more to insure deep heat (we bake about 23 pounds of sourdough, and whatever else we can organize to use the rest of the heat).

Why such a big difference? There is, potentially, some very interesting and complex physics involved, but that's probably less important than simple things like dry wood and small sticks with lots of surface area. Most important is trying different things, and learning!

3. USE SMALL STICKS

Thin wood gives the fire more surface area to burn (I aim for a couple of fingers thick; see sidebar). Burn small loads of fuel fast, hot, and completely; try to manage the fire so the *whole* floor is well heated (especially important for pizza). But when all we have is gnarly hunks too big for our home stove, I burn them one or two at a time in the oven — with small sticks as well to keep things good and hot.

4. LIVE FIRE NEEDS TO BREATHE — GIVE IT AIR

Arrange wood in loose, open stacks. If you cram the oven full, it tends to burn slow, smokey and cool, and requires *lots* more fuel to reach solid baking heat.

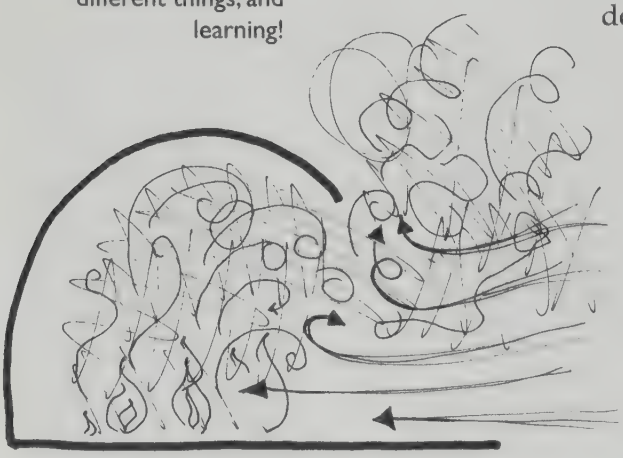
Smoke means the fire is choking. Air must be able to flow clear to the back. Watch. Small sticks or coals may be blocking air flow. Move them. Try to get live flames at the far end. Play! In general, I start the fire in front, then push it back, adding new fuel as needed to keep the fire lively. At the end, I spread the coals to burn down a bit more before I clean the oven.

5. IMPROVE COMBUSTION WITH A FIRING DOOR

The open oven doorway serves as both inlet for air and outlet for smoke — on calm days, you'll see a visible border between incoming cool air below and outgoing smoke above. On windy days, however, even small currents can disturb or prevent the even exchange of incoming air and outgoing smoke. A firing door is an effective remedy. I made mine from a semi-cylindrical piece of sheet metal cut out of an old water-heater, but any non-galvanized, sheet steel should do. The sides should fit snuggish against the doorway, and the bottom should be raised up a couple of inches so cool air can flow in smoothly below. The door also creates a short chimney directing smoke up and out, and may help reflect some of the radiant heat of the fire back into the oven. All of this facilitates a cleaner, hotter burn.

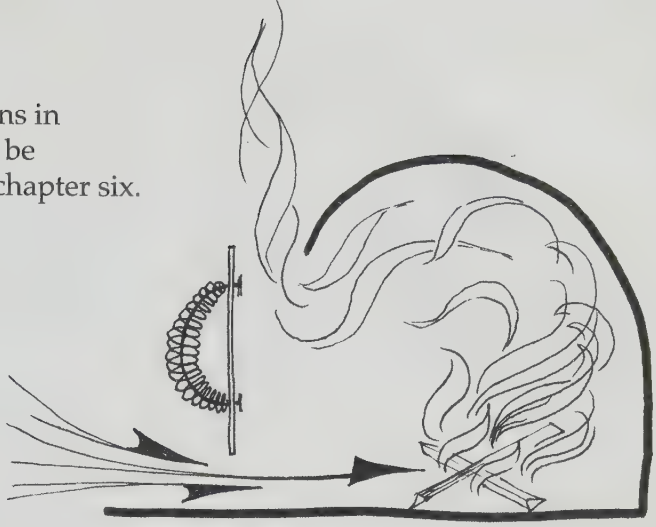
For a handle, I used stiff wire, wrapped with a coil of more wire which stays cool in use.

If you don't have time to make a door, you can create a similar effect with bricks set up around the doorway.



NO FIRE DOOR , A BIT OF WIND, & SMOKE!

For some applications (indoor ovens in particular) a permanent chimney may be advisable. For more on this topic, see chapter six.



A FIRING DOOR defines clear paths and separates incoming air and outgoing smoke. Without it, especially on a windy day, there can be immense confusion and conflict, not to mention smoke and slow progress toward baking. The diagram illustrates how the door works, but it looks and fits against the oven like a half-cylinder (below).

6. LEARN TO ESTIMATE TEMPERATURES

First you have to know if your oven has soaked up enough heat. Then you'll need to determine if it's the right temperature to cook your bread / casserole / soup / roast etc.

Depending on size, your oven should heat up in one to three hours (this varies with how much baking you do, and how thick and / or insulated your oven is). Unless you're a commercial baker, you only need to be roughly sure that the oven is ready. Various gauges give imprecise, but practical measures:

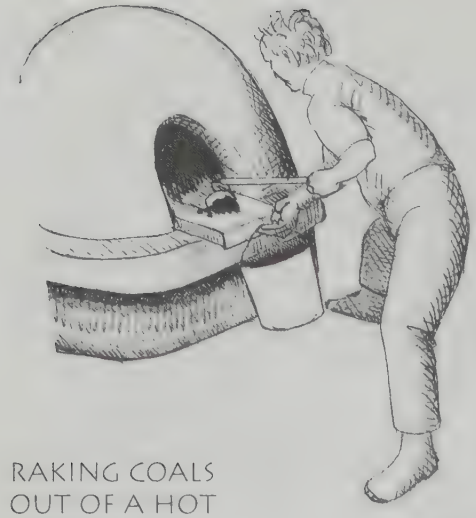
- When surface temperatures exceed about 600°F, the black soot will burn off. Often, that indicates enough heat for at least one bake. (Since we generally do several bakes, we let the fire go about another hour or so for deeper heat.)
- Feel the outside surface with your hand — depending on your oven (thickness / insulation, etc.), you can develop a sense of "rightness" by exterior temperature.
- In many ovens, a crack or two will conveniently open up as the heat penetrates deeper into the masonry (and close again when it cools). After a while, you'll know by the size of the crack(s) how far the heat has penetrated.

7. SOAK YOUR BAKING DOOR IN WATER

A nicely saturated wood door chars less, and adds steam to your baking environment.

8. REMOVE THE REMAINS OF THE FIRE

Ideally, when your oven is at temperature, your fire has burnt down to coals. Or maybe you still have burning sticks. Either way, use a hoe, shovel, metal "peel," or "rooker" (see oven tools on page 72) to scrape coals and ash into a metal container which you can cover to snuff the coals. Avoid digging into the oven walls when working around the inside corners. Also beware little hot coals that might fall underfoot. Insulated oven mitts or heavy gloves can also come in handy (leather welder's gloves are good).



RAKING COALS OUT OF A HOT OVEN

9. CLEAN THE OVEN FLOOR

Use something damp (not dripping wet) and not synthetic — no plastic brushes, no polyester rags! Cotton, burlap, hemp, sisal, or other natural bristle only. If you haven't got a proper scuffle (see next page), use a cotton rag, or mop, or natural fiber brush nailed to a stick.

10. "SOAK" YOUR OVEN

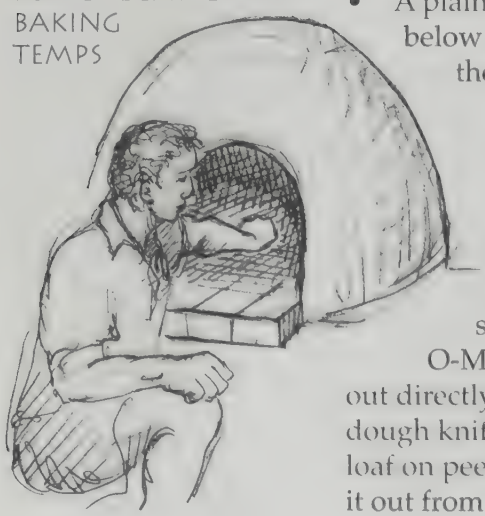
Not with water, but heat. Immediately after removing the last of the fire, oven surfaces will be at different temperatures. Give them time to even out. Close the opening with a cookie-tray, sheet metal, or other flameproof barrier. 5-30 minutes is normal, depending on your oven. Don't worry too much about it, but do...

11. TEST FOR BAKING TEMPERATURE

With practice, you'll learn to *feel* baking temps:

- First, bake off a quick pizza or two, or a few flatbreads. This tells you about temperatures, and helps cool off the hot floor. Watch how quick they cook, and how brown the bottom crust gets.
- Toss in a handful of flour. At bread temperature, it should brown in 10-20 seconds. It if chars or smokes in less than 10 seconds, allow more "soak" time. Crumpled paper provides a similar gage, but flour better indicates actual floor temperatures. For overall radiant temperature,
- I put my closed fist into the oven and count off. If I can get up to "eight-one-hundred," it's good for sourdough bread.
- A plain old oven thermometer will monitor temperatures below about 550°F; but we've broken several by putting them in while the oven was too hot.

A "HAND TEST" FOR CHECKING BAKING TEMPS



12. LOAD YOUR LOAVES

Traditionally, bakers use a "peel" to place loaves directly on the oven floor, but you can use just about any narrow board or even a piece of stiff cardboard. To help the loaves slide off, sprinkle it with a little corn meal, semolina, or Malt-O-Meal. If you proof your loaves in baskets, turn them out directly onto the peel. If you proof them on a board, use a dough knife or stiff cardboard to pick them up gently. Place loaf on peel; put the peel where you want the loaf, and whisk it out from under. Shut the door quickly to trap steam.

13. ADJUST TIME AND TEMPERATURE TO SUIT YOUR BAKING NEEDS

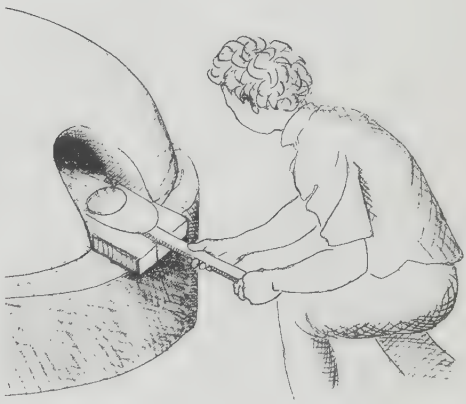
Better to have the oven hot and waiting for the bread than have the dough going slack because the oven needs to cool. If it's a warm day and your dough is lively, start your fire early. If it's cold and the dough is sluggish, slow down your fire and let the coals burn down.

Also keep in mind that you can do a lot more in your oven than bake bread. Plan your menu of the day or the week to suit the slowly declining heat of your oven. A generic lineup might start with pizza or flatbreads, sourdough bread, yeast bread, potatoes, beans, vegetables, sweet bread, pies and cookies, crackers, granola, rice pudding; roast nuts and beans (bean flour makes a great, quick-cooking soup base, as well as bean-cakes and falafel), and finally, dry fruit or make yogurt. A good way to use up the final heat of the oven is to dry the wood for the next firing. (If you don't use the higher heat for baking, however, wait until the oven is under 250°F, as hot wood can produce volatile gases. Be careful; when in doubt, wait.)

14. PIZZA & LIVE FIRE COOKING

A very hot oven cooks perfect pizza in 2-3 minutes. Roll, pull, or throw your disk of dough 'til it's 1/4" thick or less. Lay it out on a wide peel sprinkled with cornmeal or the like. Add topping quickly (not too much!), and get it all into the oven. Beware sauce and toppings near the edge; if they catch on the peel, perfect pizza may suddenly become clumsy calzone.

One or two pizzas cook easily after cleaning out the fire, but production pizza for hungry hordes requires a continuing live fire on the side or at the back of the oven. A piece of angle iron or other heavy metal helps contain the fire with a clean edge: no ashes in your pizza, and fewer burnt crusts. Two or three small sticks



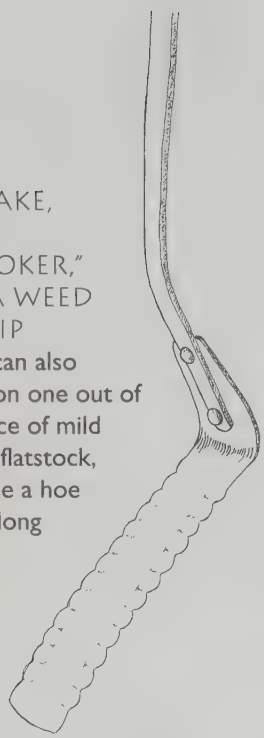
TIME, TEMPERATURE, & COOKING

Remember that cooking is a function of both time and temperature. You can bake the same bread hot and fast, or cooler and slower. If your oven is at 600 degrees but your loaves are ready to bake, fast and hot can work, with a bit more care. To avoid burnt bottoms, bake them on cookie sheets turned upside down; or check frequently, moving them as needed.

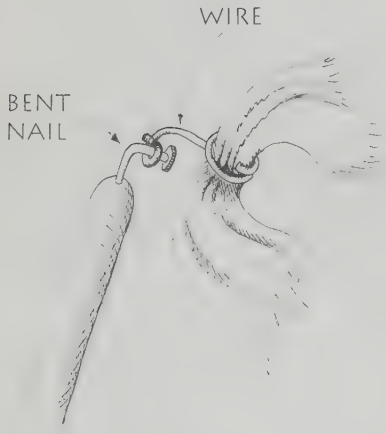
every few pizzas keeps a live flame above each one. Softwood pops and throws embers into your cheese; hardwood doesn't.

Crusts should brown as fast as the top cooks — if they don't, try shifting the fire to the other side — and work on your firing technique so the hearth gets exposed to more heat.

Live fire in a hot oven is also good for roasting peppers (char thoroughly in the flames, cool in a closed paper bag or container, wash off the char, and slice); vegetables like potatoes and parsnips (drizzle with oil & herbs and stir frequently), or for broiling steaks or fish (very fast). A live fire in a cold oven will also serve to broil meat and vegetables, though obviously it's not so quick (it won't work for pizza).



A RAKE, OR "ROOKER," AKA WEED WHIP
you can also fashion one out of a piece of mild steel flatstock, or use a hoe or a long stick.



A HOMEMADE SCUFFLE
the swivel is just a bent nail wrapped (not too tight) with stiff wire that also holds the cloth. So far, it's the best, longest-lasting swivel I've found.

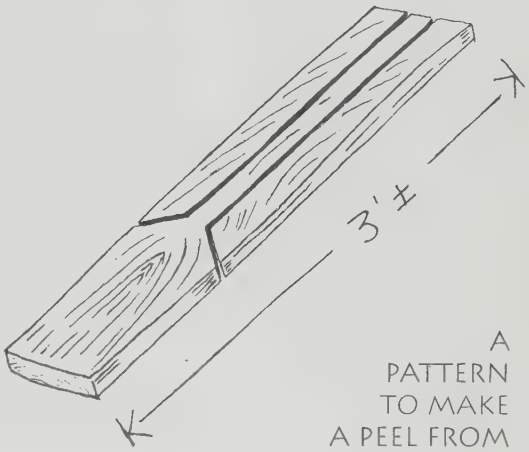
ASSEMBLE A SET OF TRADITIONAL OVEN TOOLS

- A rake or rooker is an "L" shaped piece of metal that you use to pull out whatever coals and embers remain in the oven at the end of firing. An old weed whip is perfect for the job. An old hoe can also stand in for a rooker. To catch the coals, anything metal with a snug lid will serve to snuff live embers: a metal can, a barbecue, or an old canning pot.
- A scuffle is an elegantly simple tool that whisks the floor clean with a rag on a swivel. I put a nail in the end of a stick, bent in an "L" just a bit below the head. I wrap a small swatch of cotton rag with wire, and wrap the other end loosely around the nail, so the rags spin freely. I wet and wring out the rags, and with a brisk circular motion, "scuffle" out any remaining ash and grit, even deep in the corners.
- A blowpipe: Perhaps this isn't "traditional," but it makes a good mini-bellows that can blow life into a reluctant fire. Mine is a leftover piece of 3/8" flexible copper tubing, a bit longer than my oven is deep, and crimped at one end to reduce the size of the opening, so a gentle breath becomes a powerful jet that can kindle the smallest spark.
- A brass bristle pizza brush helps remove burnt cheese and corn meal from the oven floor. Available (probably at a better price) from restaurant suppliers.
- Gloves, or insulated oven mits, make it easier to manuever hot pots or turn that pizza at the back.

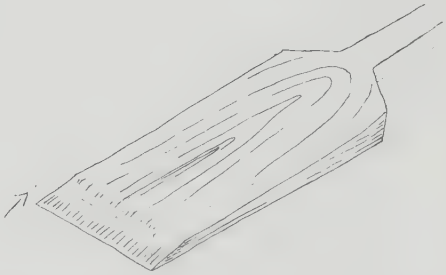
A BLOWPIPE
keeps you a comfortable distance from the smoke, and can make a reluctant fire bloom.

B. Carlson, photo

- A peel is like a thin-bladed paddle (1/2 inch at the handle to 1/4 inch at the end, sharpened to a chisel edge). Some peels are small and metal, to resist burning and to ease the shuffling of many pizzas in a big oven. Wood or metal, you can buy them ready made in different sizes from fancy catalog suppliers, kitchen stores, and the like. Or make one to your own specifications at home. For most home-sized loaves, a six-inch-wide peel is plenty. If you make a wider one (for pizza, for example), make sure it will still fit through the door. If you're short on tools and woodworking experience, nail a piece of thin masonite or plywood to a handle, and call it good (you'll still want to make a sharp edge to slide easily under a cooked loaf). If you want a more elegant tool, find a straight-grained, 1x6", hard or softwood board. Length should equal oven depth plus a couple of feet or more depending on how big and hot your oven is (make it long, and shorten as needed). Draw and cut out the shape. Then cut or split out the handle, round the edges, and thin the blade until it will slide easily under a cooked loaf.



A PATTERN TO MAKE A PEEL FROM A 1 X 6 BOARD



USE A KNIFE, PLANE, CHISEL, OR SAW TO GIVE YOUR PEEL A SHARP, SHOVEL-LIKE EDGE

WORK IS LOVE MADE VISIBLE. AND IF YOU CANNOT WORK WITH LOVE, BUT ONLY WITH DISTASTE, IT IS BETTER THAT YOU SHOULD LEAVE YOUR WORK AND SIT AT THE GATE OF THE TEMPLE AND TAKE ALMS OF THOSE WHO WORK WITH JOY. FOR IF YOU BAKE BREAD WITH INDIFFERENCE, YOU BAKE A BITTER BREAD THAT FEEDS BUT HALF OUR HUNGER.

– KAHLIL GIBRAN, THE PROPHET

CHAPTER FIVE: SIMPLE SOURDOUGH BREAD

'ARTISAN' BREAD

There's no true artisan bread in America, because we have sold out the ways of life that made it possible. Artisan products were made by craftsman and traded in a craft economy where value was born of life, labor, love, and beauty, and varied according to need. From a bit of flour and water, and a bit of honest labor, a baker made a beautiful loaf of nourishing bread, and used it to pay for flour and salt; the farmer paid the miller in grain, and gave the tanner skins for leather to give the shoemaker in return for shoes. So baker, miller, farmer, shoemaker fed and clothed each other, and knew the value of things by their own sweat and pride. Anything left unused went back to the soil and kept it fertile. In a pinch, money filled in when there was nothing to trade. Such nourishment we can hardly understand, much less know.

We are born into an industrial "growth economy," in which we manufacture garbage and destroy nature. Everything is for sale and nothing lasts. Most of us survive enslaved to jobs, and can only watch as nature is "developed" into "goods" that we "consume" and then send to the landfill so the economy can "grow." Relationships are reduced to money, an extreme and distorted simplification of life's beautiful complexity. Instead of reality, we get "reality TV."

The baker must pay cash for flour, rent, utilities, insurance, bringing the bread to market, not to mention milk for the children. Boom — a loaf of good bread seems cheap at five dollars. But money is not a value, it's a means of exchange. Bakers and other artists will attest that price doesn't equal value. It's not money that makes beauty and flavor — it's hands, love, art.... And the beautiful loaf, created in love and ferment, is only truly beautiful when eaten by the body that will transform it again, into new life and new love....

So. If you want artisan bread, become your own artisan! Make more than you need, and give it away. People are grateful for real food. They will return the gift, if not directly to you, then to someone else. If we really want artisan bread, we not only have to assert the value of art, of time, of love — we have to guarantee it, with our own art, our own time, our own love. That is what makes real bread.

Bernard Clavel, a French writer whose father was a baker, wrote that the bakeshop was on the way to local saltworks, and that his mother would open up at five in the morning so that the salters could buy bread on their way to work. His father sold bread to the wine-growers, some of whom gave a cask a wine in exchange, and to the wood-cutter (huge eight-pound loaves), who in return would deliver the wood needed to fire the bread-oven.
When the baker ran out of salt, he would drive up to the saltworks to pick up a sack, paid for — in bread. [see Clavel's introduction to *The Book of Bread*, by Jerome Assire, Flammarion, 1996, Cited in "Cooking with Fire in Public Spaces," Friends of Dufferin Grove Park.]

HANNAH & BREAD
M. Chuckovich, photo

WILD FERMENTATION & KEEPING FOODS FRESH are books that explore live, fermented foods such as cheese, yogurt, beer, wine, vinegar, pickles, sauerkraut, tofu, miso, and even meats! The principle of fermentation is not to *preserve* food so much as to keep it alive (perhaps baked bread is the exception that proves the rule?) Fermented foods have sustained people of many cultures, for millennia.

INTRODUCTION

Hannah has three rules for bread: "Patience, Wonder, and Nae Stress." She started making bread at 14, spent several years baking professionally, and now bakes about twenty-five pounds of dough at home, every two weeks. Below, she describes her routine, along with suggested amounts for a smaller batch. If you're already a baker, you can pick and choose any particular twists you like; if you're new to baking, read through it all to get a sense of the whole before you start.

The key to sourdough is remembering that it's alive, like all fermented food: sauerkraut (German for "sour cabbage"), yogurt (soured milk), miso (fermented bean paste) — not to mention beer and wine. The 'souring,' or fermentation, is done by wild yeasts and bacteria that are everywhere — on the grain, the grapes — even on our hands. So when you combine flour and water, those wild organisms bloom and ferment. You provide them with water and food in the form of flour, they produce carbon dioxide as a byproduct, and this is what leavens the bread. All this wild activity also makes the wheat more digestible and nutritious; and makes possible a tasty, long-lasting loaf of good food!

Making sourdough is an experiment that anyone can re-create. A 'recipe' just provides basic information but, like dancing, you learn by concentrating on the music and your partner (flour and starter), and by jumping in to find your own rhythms and style. Here's Hannah:

Good bread takes time, but it does not take time from you. Think of it as gardening, if you are a gardener...plants grow in their own sweet time, and though you can adjust a great many things about their environment you can't do the growing for them...you have to wait. And while you wait, for your sourdough or your onions, you can do the hundred and one other things you want to do.

The basic process is simple. The directions that follow are

for a simple three loaf sourdough recipe (and a bit extra to make a pita bread or two in the initial extreme heat of the oven). I assume some familiarity on the reader's part with making leavened bread. I should also say that when I make our 24 pound batches of dough every other week, I don't weigh the flour or water — just the final dough and the salt. Every batch is a little different and I like it that way. But I have adapted my methods to come up with an easy-to-follow recipe if you're wanting one. When we teach oven and bread workshops, we come across a fair number of people who are confused or intimidated by sourdough (one woman journalist just brushed the matter aside by saying, "it's a guy thing"!) If you spend hours poring over the many beautiful artisan bread books around, comparing this formula with that, these baker's percentages with those, this starter-schedule with the other one, you could easily feel overwhelmed. So, whilst I admire many of those books, I'm offering something different here. People are stressed out enough without feeling they must control *every* moment of the process. "Staff of life," maybe, but let's not beat ourselves over the back with it. You can have great bread without great stress.

PIZZA FROM A FALCON OVEN
built by the author for a housing development in Oregon. Note the bucket under the ash dump slot. For more about the lime-plaster, fresco finish, see the color section.
H. Field, photo

FOUR STEPS TO BREAD:

WHAT YOU DO	WHEN YOU DO IT
1. Feed starter, twice	(3 pm & 11 pm, the day before)
2. Make dough	(7 am on bake day)
3. Ferment dough	(7 am to 3 pm)
a. knock it back	(mid-morning)
b. divide and mold it into loaves	(midday)
c. set loaves to rise & heat oven	(midday)
4. Bake dough (2-4 hours later)	(mid-afternoon)

The timeline is just an idea of how things work — but I seldom make bread on the same schedule twice. How? By recognizing and responding to three things: temperature, time, and starter. I adjust temperature by warming or cooling the flour, water, and dough, as well as the thermostat; I adjust timing by how long I prove or retard the dough, and when I "knock it back"; and finally, I watch the starter and use more or less of it to shift how fast or slow things go.

TRUE WEALTH is a full bread shelf. Sourdough generally keeps very well (don't refrigerate! It actually encourages staling). However, our wholewheat loaves, which are quite moist, would sometimes get mold spots during warm or damp weather. After testing many strategies, we've found that we get the best results if we keep the bread on this open, well-ventilated bread shelf. Our loaves now keep easily for two weeks, even in summer. Even a completely dry crust still tastes good; toasted and soaked in soup its almost as good as fresh.

THE RECIPE:

1. 10 cups flour (we use mostly fresh ground, hard white spring wheat. Try all wholewheat, half white/half whole, or all-purpose with a bit of rye!...experiment!)
2. 4-4.5 cups water
2. 3-1/2 teaspoons salt
4. 3/4 cup starter (measured right after feeding, as it grows in volume! If you have none, see the end of the chapter.)

STEP 1: ACTIVATE & PREPARE STARTER (1ST & 2ND FEEDINGS)

Active starter has been left to ferment from 4-8 hours after a feed and is full of bubbles — it looks alive. To reach this point you need to begin 16 hours or so before you want to make dough. I keep a small ball of starter in the fridge.

Say at about 3pm the day before I want to bake, I take 1 tablespoon of starter, mix with 2 tablespoons of flour, 1 tablespoon of water and mix it together, let it sit at room temperature for 8 hours or so.

At about 10 or 11 pm, before I go to bed, I feed it again by adding 8 tablespoons of flour and 5 tablespoons of water. I measure out what I need (3/4 cup for this recipe), put the remaining 1 tablespoon into a clean, loosely lidded jar and put it back in the fridge. (If you ever forget this step, you can pinch a lump of dough from a proving loaf and put that in the fridge. Salted starter isn't ideal, but a few feedings will quickly diminish the impact of any salt.)

Next morning, about 8 hours after the 2d feeding, the starter is ready to be incorporated into the dough.

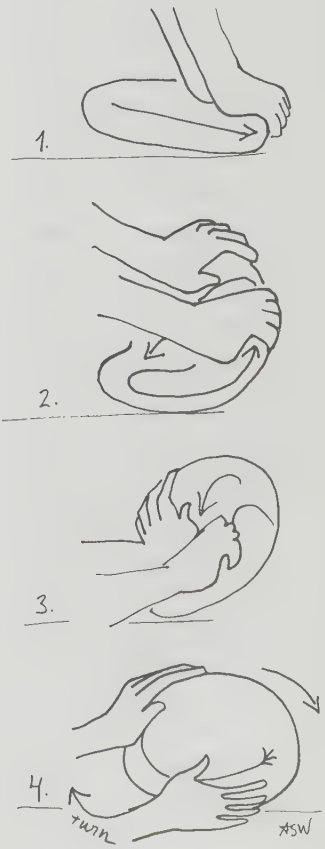
STEP 2: MAKE DOUGH

KNEADING CAN BE EASIER FROM ABOVE

Kneading is key to good bread. Wheat flour contains gluten and gliadin, proteins that, when hydrated and kneaded, turn into long, elastic, extensible chains, which trap the CO2 produced by yeast during fermentation.

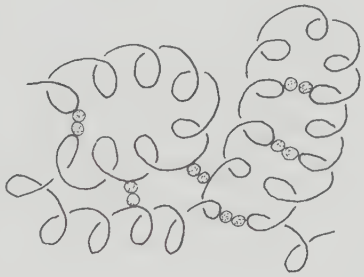
It is not critical exactly how wet or dry the dough is. Since I'm no longer a commercial baker, I don't expect (or want) to make exactly the same loaf every time, so I don't worry. I can vary my 'same recipe' greatly just by changing the amount of water in the dough. Dry dough gives a denser texture or 'crumb;' wet dough a more 'open' and springy one. With this recipe, start by adding 4 cups of water, then the extra half cup in increments 'til you get a dough that doesn't feel too *tight*. Flours vary in how much water they absorb, both according to the type of wheat and daily humidity. Hence it's impossible to give precise amount of water. It's all in the hands — after a few batches you'll be able to *feel* if the dough is too wet, too dry, or just right.

So mix all the ingredients except salt — just enough to incorporate everything. Then let the dough rest — anywhere from 15 to 60 minutes. That gives the flour time to fully absorb the water, the protein chains to lengthen and relax, and fermentation to begin. That 'conditioning' means less kneading!



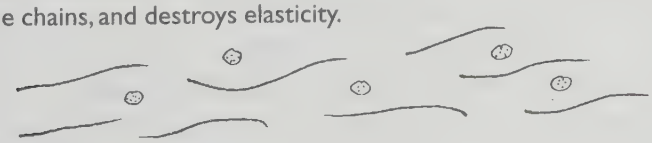
ABOUT KNEADING

Gluten molecules are long, kinky chains of amino acids. The atoms (small circles) attract each other to make the kinks.



Kneading loosens kinks and aligns the chains.

Over-kneading breaks bonds, dissolves the chains, and destroys elasticity.



(After an illustration in *On food & cooking*, by Harold McGee.)

GRIND YOUR OWN

All grain mills are not alike, and the milling of good flour is as much an art as any other part of the loaf. We have used three or four different mills: manual "corona" type mills with steel burrs, as well as two electric mills with synthetic stones, one high-speed, and one low-speed. By far the nicest flour comes out of the low-speed "Retsel," which came to us as a gift. When we started using it, it seemed the flour had a distinctly different feel: slipperier, smoother, and almost a bit clayey. By comparison, the flour from the high-speed mill seemed gritty and coarse. While we made nice bread with both mills, further exploration revealed that slow-rotation mills not only keep the flour cool (heat destroys nutrients), they also *rub* the grains rather than shattering them. The result is a flour made of flatter particles with greater surface area (which also improves hydration). Alan Scott also says that slow grinding with good stones will blend the oils from the kernel into the flour, thus reducing the risk of it going rancid.

Time to add salt. (If I'm not using a recipe, I figure 1 tsp of salt for every 1.5 lb loaf. This is the only place where the amount is fairly critical.) Salt improves the texture of the dough by toughening the gluten, but it also inhibits fermentation, which is why it's good to add it as late as possible.

There are many ways to knead, but basically, you're aiming at turning the 'shaggy mass' of just mixed dough into a cohesive, elastic, smooth ball. 10-15 minutes of kneading is required

Don't add too much flour! Many people don't like sticky fingers and mess. This results in them adding flour and more flour 'til nothing sticks. And that results in a dull and boring loaf. Loaves, as with love, do better with lubrication. The wetter the better, both to stop the dough sticking and to improve hydration. So dip your hands in water whenever you find them dragging in the dough (scrape them clean in-between times too).

To test if the dough has been kneaded enough, take a small handful and stretch it out with both hands like a piece of rubber balloon. If it thins into an even, translucent sheet, it's kneaded. If it's just ropy and tears apart, knead more.

I wait until the very end to add spices, herbs, sesame seeds or dried fruit, since some spices inhibit fermentation, and seeds and nuts can tear up the dough and reduce the volume of the loaf. I knead them in gently and quickly.

STEP 3A: FERMENT, & KNOCK BACK

Fermentation is the key to flavorful bread. It's an ongoing process from the moment you introduce the starter to the flour and water until the loaves inside the oven reach 120°F, at which point fermentation stops as the yeasts die. The key ingredient is time. Experiment to see what you like — longer ferments make more flavor and more "sour;" fast, short ferments can produce bland loaves.

Knocking-back is a technique used to prolong fermentation — you leave the dough in bulk 'til it doubles in size, and then you "knock it back" — by gently compressing and degassing it. This gives yeast organisms new reserves to feast on, and they develop more flavors.

If my schedule requires it, I'll skip bulk fermentation almost entirely, dividing and loafing the dough soon after kneading (with maybe half an hour to let the gluten chains relax so I'm not fighting them). Then, to maximize flavor development in the one rise I let the bread do prior to baking, I let it proof on a long, slow, cool fermentation (i.e., cool water, cool room).

STEP 3B: FERMENT, & DIVIDE LOAVES

I scale my loaves at 1-3/4 lbs, as I like them to all finish cooking at once. (Mine is an old 24 lb unit, $12 at a used store.) I divide any extra dough into 2-4 oz. pieces, rounded into balls for pita bread, and left on a floured board with cloth on 'til bake time.

Then I "mold" them into balls so the crease is at the bottom. This is hard to describe in words (but easy to demonstrate!) I roll the dough and press it against the table with the inside of my hand. Tension is key to creating a smooth uninterrupted 'skin' on each loaf, which in turn makes the form-defining crust. Hint: let the loaves sit for ten minutes or so, while you flour your baskets, then reshape them. The ten minute rest lets the gluten relax again so you can produce a tighter loaf. Formed loaves go upside down in floured baskets.

RISING BASKETS

Thrift stores are a great source for non-varnished, smallish (8" diameter at top) woven wicker baskets — from 50 cents to a dollar. Beautiful European willow baskets made specifically for bread-raising are beautiful and very durable, but cost $30 each. The fifty cent ones are good for at least 5 years or so. You can also rise loaves in between the folds of a piece of heavy canvas or other tightly woven cloth.

WHY BASKETS?

Sourdough, artisan loaves generally prove more slowly than yeasted ones and are often wetter, so benefit from support as they rise to maintain their shape. The loaves then get covered with a damp cloth and left to rise. If I'm in no hurry, I leave them for about 4-6 hours at room temperature (which is mid 60s in our house, not the 75°F of most cook books). If I'm in a hurry, I leave them for about 2 hours in a warm place (such as near a radiator). If I'm in the opposite of a hurry, I leave them for 6-10 hours in the fridge (or, at one workshop this summer, in the boot of the car on a cool summer night). This last might need "goosing" with a warm rise at the end. This is useful if you need to go to bed, need to go to work, whatever. You choose. Remember that.

A NOTE ON TIME:

Readers will notice I say "*about* 16 hours," "*about* 8 hours," "*about* 4 hours." How vague is this? The key to being in control of what happens when is temperature. If you go for the low-temperature, slow ferment approach, you'll have a lot more leeway, say 16-20 hours — than if you do things hot and fast, when 20 minutes here or there can make a big difference. So make the most of not being a commercial baker, and go slow!

STEP 3C: FERMENT, & FIRE THE OVEN!

Exactly when you fire up your oven can vary greatly, depending on your oven, your bread, and what else you're planning on cooking in the oven. In general, however, you'll probably want to fire your oven for somewhere between one and three hours — about the same amount of time that your loaves will need on the quick-rise schedule. So just before or just after I loaf the bread, we get the oven going. If it's a hot summer day and my starter was very active, they prove faster and the oven will need to be ready sooner. If it's cold and wintry and the house isn't very warm, the oven can wait until a bit later. When in doubt, fire it up sooner — it's easier to have a hot oven waiting

for bread than the other way round. You'll also want to take a look at chapter two, on "Firing and Baking in Your Oven," p. 43). We typically fire ours for 2 hours or more (including soaking time), and need the heat to be deep enough to bake 2 batches of bread, followed by pies/stews/meat/vegetables/steamed bread, etc. If you only want to bake one batch of bread, allow less time — this is all an opportunity to experiment. The main thing to remember is that it's better to have the oven too hot than not hot enough. But you can also knock the bread back again (deflate and reshape the loaves), or speed up their rising. Somehow it nearly always works. Patience. Nae stress.

If you are using an indoor electric/gas/conventional oven, pre-heat it to 500 for at least an hour before you bake — preferably with a baking stone, bricks, or other heat retaining mass floor in the oven to improve the crust of the bread.

STEP 4: BAKE!

When the oven floor is clean, but before the equalizing soak, the temperature is ideal for pita bread, which cook in a minute or two. Evenly roll out your small 2-4 ounce balls into small circles a scant quarter inch thick. Place on a peel, slip into the oven, and watch. In 30-60 seconds, they'll puff up into a beautiful sphere. I leave them 10-20 seconds longer, then pull them out. The intense heat causes the water in the bread dough to turn to steam which, in trying to escape, inflates the disk to make a perfect pita pocket. Tear it up right away and eat with good butter, or olive oil and garlic, or stuff with salad, feta cheese, whatever you have to hand. (They dry out quickly and don't keep so well.)

When your oven has reached a good baking heat (see page 70), turn each loaf out of it's proofing basket onto a wooden 'peel,' dusted with cornmeal to help it slide off. Using a razor blade or sharp knife, carefully held at about 45 degrees, slash each loaf deeply. This controls splitting as the loaf "springs" in the hot oven, as well as making a more beautiful crust. The steam which makes for a trademark "artisan" crust will be adequately provided by the dough itself — each pound of flour will give out about 2 ounces of water as steam. If you must add water for steam (for a small batch of bread, for example) you can use a spray bottle — but regular spraying will shorten the life of your oven, unless you have a high-pressure "misting" nozzle or an electric steam cleaning unit that will prevent liquid water settling on the oven.

HOW DO I KNOW THE LOAVES ARE READY TO BAKE?

The trick is to bake before the dough has fully risen, before it's doubled in size. I press my finger lightly into the dough and look for an impression that doesn't spring back quickly. Better to underproof than overproof...but experience will tell!

WHEN ARE THE LOAVES DONE?

A stem thermometer plunged into the loaf should read 190°F or a bit above; over 200°F is overbaked — it will taste OK, but stale quicker for lack of moisture.

Other signs are touch and sound — these really come from experience. The loss of water during baking makes a lighter loaf; handle enough 1.75 lb loaves, and you can tell when they're down to 1.55-1.6 lbs. A baked loaf also sounds hollow when rapped on the back with your knuckles — but beware, the superior crust on hearth baked loaves can give you a false positive result — i.e., the crust is fully baked, but the center may need a few more minutes.

Remember too that bread continues to cook out of the oven. Tempting though it is, try to wait an hour before breaking into a warm loaf, else you'll find it a bit gummy. This is another reason to make pita bread — make use of the too-hot-for-regular-bread oven heat, and have something to curb your impatience and hunger for fresh bread without sacrificing an actual loaf. Cool the bread on wire racks so air circulates freely around it.

INGREDIENTS

FLOUR:

We use organic flour. For the wholewheat loaves I make these days, I find fresh ground is best (buying berries is also cheaper than buying flour) — the dough is livelier as well as sweeter. I use hard white or red winter (or spring) wheat berries.

If you're wanting all or partially white loaves, use an all-purpose flour rather than 'bread' flour. The latter will of course work, but in hearth breads, the higher protein wheat tends to make for a rubberier crumb. Pastry flour (or lower protein "all purpose" flour in some parts of the country), which has less gluten-forming capabilities, will make a dense and more crumbly loaf. Rye contains different proportions of the gluten forming proteins, and less gluten. Instead, gas in leavened rye is trapped mostly by chains of sugars called pentosans, which form a gum when hydrated.

Some people who think they are allergic to gluten might actually be allergic to just wheat, or even to commercial yeast, and so can enjoy pure naturally leavened rye. True gluten intolerance, however, applies also to rye.

Also keep in mind that wholewheat and whole rye flours have a greater mineral content than white, which can aid fermentation — even if you use just a small amount.

ISN'T WHITE FLOUR "BAD FOR YOU"?

Not Always. Harold McGee explains how Irish citizens suffered when WWII rationing required them to eat whole wheat bread instead of white. It turns out that processing *increases* the availability of certain essential nutrients (though it may decrease the *quantity* of nutrients overall). McGee says "brown [whole grain] bread contains more nutrients than white bread, but makes it more difficult to absorb them." There is another part to the story, however. The *fast* ferment of commercial yeast is very different from the long, *slow* ferment of natural sourdough. Not surprisingly, the latter *increases* the amount and variety of nutrients available from whole-grain flour. See McGee's very good book, *On Food and Cooking*.

THE BIBLE FOR COOKING IN A WOOD-FIRED OVEN

Well, we haven't written it, but I think that in cooking (as in other things) direct experience is the best way to the truth. Along those lines, rather than duplicating recipes that you can already find in a number of standard cookbooks, we started keeping a journal of sorts to record how we actually fire the oven, what we cook, and how it all worked. We thought it would be best to post it in the archives at handprintpress.com, along with some other things that we thought some readers might appreciate.

WATER

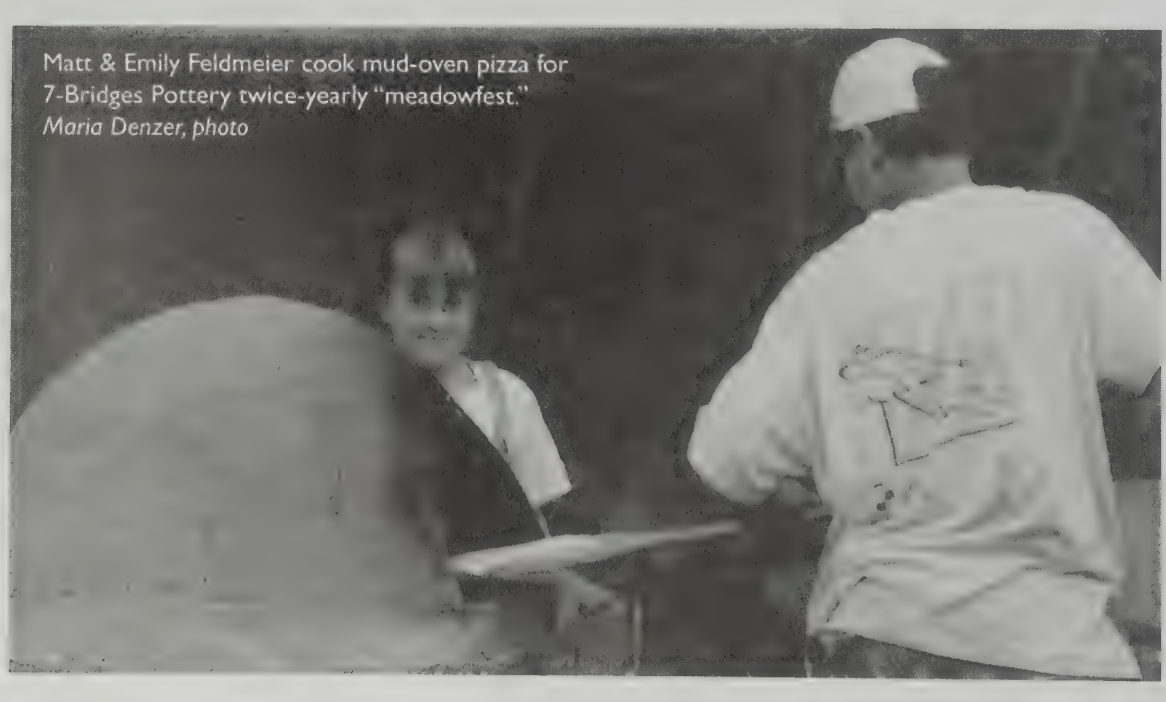
How much water you add to your flour depends on what dough you're after, and what flour you use. High protein flours generally absorb more water than low protein ones. Doughs vary in their 'wetness', from the stiff doughs of Latin America, to the by now infamous wet slippery dough required for good ciabatta. Generally, the softer (wetter) the dough, the more extensible, irregular, and chewy the crumb.

Hard or heavily chlorinated water might affect your bread by inhibiting fermentation. In the first instance, you could buy bottled water; in the second you could simply let the water stand overnight at room temp to evaporate the chlorine.

SALT

Avoid iodized salt. Sea salt is available cheaply in bulk in most wholefood stores. I've nothing against the many "gourmet" salts available these days, but get the finer grained stuff, so as not to tear up any gluten strands.

Salt is a fermentation inhibitor. Bakers use it to control fermentation, to produce moister loaves, to make bread taste good, to give color to the crust and to toughen the gluten which makes the bread hold more CO_2 as the dough ferments. (It is gluten's ability to trap the bubbles of CO_2 from fermentation that lets the dough rise; that's why wheat is the grain of choice for leavened breads).



Matt & Emily Feldmeier cook mud-oven pizza for 7-Bridges Pottery twice-yearly "meadowfest."
Maria Denzer, photo

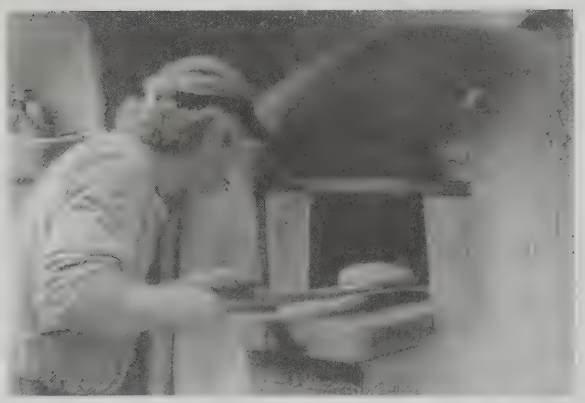
SCALDING

Scalding your flour with boiling water is an ancient practice that bursts the starch granules in the flour, releasing additional food for fermentation and making the dough sweeter. (Tuscan saltless breads are made with scalded flour in part to offset the flavor losses due to lack of salt.) The practice may have begun with brewing, to accelerate fermentation and perhaps increase alcohol content. In addition to the additional food for yeasts, scalding the flour also puts a higher percentage of water into the dough, making a wetter, more tender crumb, and loaves that won't dry out so fast. Scalding can make a nice tender whole-grain, sourdough pizza crust. We've also had some success using it in experiments with the kind of low-protein, "soft" wheat that we grow in Oregon. Monica Spiller has done extensive research on the uses of scalding, and has put much of it on her website, barmbaker.com.

We typically scald about 1/10th or less of the flour in a batch of bread (more if we're using soft wheat). Pour boiling water on flour, stirring constantly. Say 1 cup of the flour in this recipe with 1-1/2 cups boiling water. Then add 1-1/2 cups cold water — stir 'til it's like smooth porridge. Let cool to room temperature (cover to prevent skin forming), then incorporate it with bread recipe (minus the 3 cups water, and 1 cup flour). Experiment.

PLIMOTH OVEN

During a trip back east, we were invited to Plimoth plantation for a tour, and to discuss traditional ovens and cooking. I'd been there in gradeschool, when it was a dull and lifeless exhibit of small objects and large amounts of text, so I was unprepared for a real village of mud-plastered shacks, real gardens, actors speaking in period dialect (pronouncing the "k" in knife and know, for instance), and this Canadian style oven. As it turned out, they probably had English "clome" ovens. The other surprising fact was that these "founding fathers and mothers" had indentured themselves to London investors in order to fund their freedom. In return for seven years of labor, they got passage, supplies, protection, and the right to settle (again) in another location.



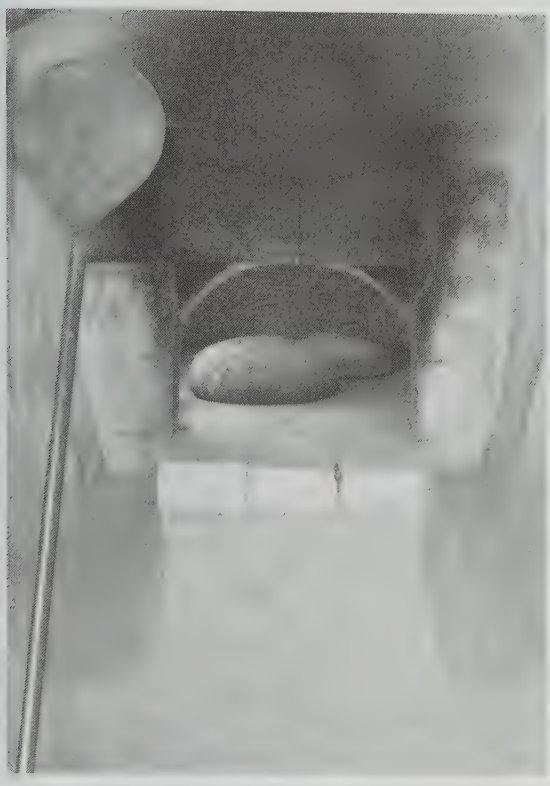
LOADING LOAVES
In quick succession: sprinkle peel with cornmeal, tip dough from basket, slash the loaf, put it in the oven — easier with more hands. A friendly baker told us to make a professional quality "lame" for proper slashing by threading a safety razor blade onto the tine of a metal leaf rake.
Marie Oliver, photos

STARTER

Here's the low down on starter if you don't have some already: Starter, "levain," "chef," sourdough are all terms describing a fermented mix of water and flour. This is nurtured 'til the wild yeast population is strong enough to leaven bread.

This is where the "wonder" of bread-making comes in: simply mix 1/4 cup flour and 1/4 cup water at room temperature. Let sit for a few days and you'll notice bubbles and a yeasty smell: signs of fermentation. Discard 1/4 cup, then feed what's left with 1/4 cup flour, 1/4 cup water. Leave for 8 hours at room temperature. Repeat every 8 hrs for a week or two (including discarding 1/2 of it each time). As it gets stronger, it will get more bubbly. After a few weeks it should be ready to go. Or ask around and see who might give you some of theirs.

Once your starter is strong enough to leaven bread, you needn't keep it out at room temperature, nor feed it so often. Mine sits in the fridge for 12 days out of every 14. I just get it out 16 hours before I incorporate it into the bread dough. (See steps 1 and 2 earlier). Always remember to put some *back* in the fridge after it's had 2 feedings; and it's best to put it in a clean glass jar to avoid mold problems.



FINISHED BREAD
In looking through all my photos for this new edition, I'm struck by how difficult it is to capture the magic of the oven. You can't see the heat, and most photos can't convey how it feels to deposit a cold lump of dough into the darkness of the void, and then come back 30 minutes later to discover a warm golden loaf. This staged shot (with a flash in the oven) is a fair approximation; you get a good feel for it, too, in Hannah's expression on the title page.
Milan Chuckovich, photo.

HOW MUCH STARTER TO USE

Another way to control the fermentation rate of your dough is to vary the amount of starter you use. I tend to think that "less is more" — and find that halving the starter does *not* halve the rate of fermentation. It slows it certainly, but I think it makes the starter work harder — a workhorse versus a pampered pony. Typically, starter is 6-12% of my final dough weight. Many recipes use up to 30%. I guess they're in a hurry.

WHAT IF THE STARTER GOES MOLDY?

If there's a faint 'bloom' on it, I'll generally scrape away the offending part and use what's left. If your whole starter has gone bad, throw it out, and start over.

HOW IMPORTANT IS THE CONSISTENCY?

If you want the same bread every time, starter consistency may be important, but over the 8 years of its existence my starter has been the consistency of pancake batter, peanut butter, thick cream cheese, and now just like bread dough. Starter consistency will change the final dough, but think of it as biodiversity — none of the differences are bad! Starters are resilient. Treat them with love and care and they'll last you a lifetime.

EVEN "ROUND, FLAT, SOUR BRICKS" CAN INSPIRE POETRY

HAIKU
BY BOB CARLSON

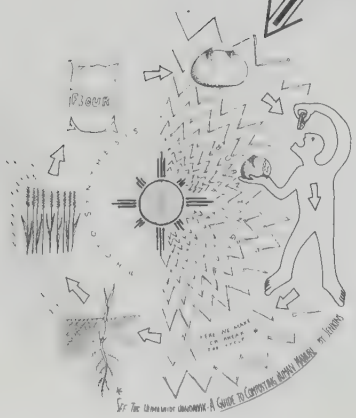
Round bricks, chewy, sour:
With Tillamook extra-
sharp,
Beer-making goes well.

Like a map of Mars
Crust craters, canals,
shadows —
why is it so flat?

Marla from Brooklyn says
"you can't buy bread like
that here."
She should know.

Soaking up the soup,
sour as love-lost regret, it
fills the empty space.

Short, stout, round,
wrinkled
Like my favorite aunt,
Myrt — she made
good bread, too.



FIRE IS HALF OF THE BREAD CYCLE (P. 6)
It rules the equation of burning, on the other side of photosynthesis. Fire burns fast; metabolism is slower. A clean fire produces energy (heat), carbon *di*oxide gas, water, and minerals (ash). A dirty fire creates energy, carbon *mono*xide gas (poisonous and flammable), water, ash, and unburnt fuel (smoke and soot). That is why you get smoke before fire — because the reaction hasn't heated up enough yet to burn hot and clean.

CHAPTER SIX: PRINCIPLES FOR BURNING

THE METAPHYSICS OF FIRE

In biology, there are two fundamental equations: the equation of burning and the equation of photosynthesis. Photosynthesis is how energy, carbon dioxide, water, and minerals combine to become the living flesh of plants. Sunlight provides the energy, and soil the minerals. Combined with carbon dioxide and water, it is life (see the Bread Cycle on p. 6)

But what about those who can't digest pure sun, rain, air, and earth? For them, there is the equation of burning, a fundamental chemical reaction between oxygen and the rest of the world. Even metal burns at high enough temperatures. At low temperatures, the reaction just slows down and is called rust, oxidation, or (in warm bodies) metabolism.

Whatever you call it, burning happens most of the time to most materials on the planet. Indeed, it's a miracle that our atmosphere maintains an oxygen level just shy of what would cause spontaneous and total combustion. So when you touch a match to something flammable, you're just adding heat to the ongoing reaction between fuel and oxygen. The energy of the match speeds up the reaction to the point where it creates more heat than it uses. The heat breaks chemical bonds and releases more energy to break more bonds. With adequate fuel and oxygen, and nothing to cool it down, the reaction grows.

The variables are the type of fuel and the reaction speed. Fuel is a combination of carbon and hydrogen — from "fossil fuels" ("hydro-carbons,"from the fossilized bodies of once living plants, to "carbo-hydrates" (sugar & starch), or protein and fats (more hydro-carbons). Our metabolism operates at a very slow rate, so we don't spontaneously combust, but we really do "burn" the calories we eat. Oxygen reacts with carbon and hydrogen, producing carbon dioxide, water, and energy (enough to keep us at 98.6°F).

The burning of a wood fire is just a faster version of what makes the muscular and nervous energy that lets you grab a carton of milk in the supermarket — but it's also slower than the (explosive!) burning of fossil fuel in your car engine as you drive home to deliver the carton of milk to your kitchen table.

What's this got to do with ovens and bread? Everything! Human (and planetary) history begins (and may end) with one question: What, when, where, why and how do we burn?

"BAD" EFFICIENCY? Consider a cautionary word about "the Jeavons Paradox," from Wes Jackson, of The Land Institute, in Kansas:

"William Stanley Jevons was a British economist whose 1865 book The Coal Question *showed that in industrial England greater technological efficiency led to more resource consumption...."*

Jackson's point is that efficiency can't help us if we use the "savings" for things like "economic growth," which typically increases demand for whatever it is we're "using more efficiently."

Whether you call it science, religion, or magic (Moses and the burning bush?) — burning is an extraordinary and essential fact of life, one that commands respect and reverence, especially when you realize that the fire in your oven and the fire in your belly are the same marvelous thing. Bread is sunlight, stored in grain, christened by water, inspired by fermentation, and transformed again and again, by fire. Grace, communion, gratitude....

EFFICIENCY: A PRINCIPLED APPROACH TO BURNING

When you have to gather sticks of wood to cook your food, you tend to try to cook with as few sticks as possible. This is a practical definition of efficiency. Another definition might be to use fuel so that our use doesn't diminish or threaten the life of the whole — either by decimating forests or sending smoke into a neighbor's window. In the fire itself, the principle of *efficiency* means adequate mixing of combustibles, so the fuel not only ignites, but burns completely. A "clean" fire would produce no smoke, since smoke is unburnt fuel. A "dirty," inefficient fire allows fuel (smoke) to escape. Three variables determine how well, how clean, and how efficiently your fire burns: time, temperature, and turbulence.

TIME & TEMPERATURE

If you rub two sticks together, they won't burn until friction and pressure have raised the temperature to the point of ignition, and held it there long enough to initiate and maintain combustion. Dry fuel is critical, because moisture both lubricates and cools, reducing friction and heat, and making combustion slow or impossible.

Putting a match to paper speeds up the reaction considerably, and good dry fuel will insure the highest temperature. But how do you insure that your burning fuel is well mixed with the hot air that it needs to burn? Well, what do you do when you've rubbed your two sticks long enough to make smoke and a little fire? You *blow* on it; not so hard as to cool it, but just enough to add oxygen and stir it all up. That mixing is...

TURBULENCE...

...which is created by a flow of air that not only *delivers* oxygen to the fire, but that also mixes it up with flammable

MEXICAN TURTLE
Built by Coenraad Rogmans and paricipants in a workshop in Zipolite, Mexico. (See resources for contact info.) *Rogmans, photo*

gases so that they burn as completely (and cleanly) as possible. The location of the turbulence is critical. If incoming air swirls around the oven doorway, it will actually block airflow into the fire and cause combustion to slow down, cool off, and go smoky. The air needs a clear direct path to the heart of the fire; that's where you want the turbulence. A blowpipe demonstrates this well: the closer the end of the pipe gets to the fire, the brighter the burn.

AN *IMPRACTICAL* DEFINITION OF EFFICIENCY

Efficiency is beautifully related to *masonry*. In Latin, *facere*, means "to do," or "to make." The prefix "e" is from "ex" meaning *out*. So *effect* is what comes out of our making. *Masonry* is from a Germanic root, "mag" or "mak," meaning "to fashion, or fit." So masonry is the *doing*, and efficiency is the *result*. Should we really reduce all that to no more than a number? Perhaps efficiency is not pounds of wood burnt or bread eaten, nor thousands of dollars saved or earned, but rather a relationship: a depth of understanding, a breadth of gratitude, a wealth of wonder. Perhaps, to better participate in the greater creation of the world, we need to *do* less and *see* more.... Perhaps "efficiency," "inefficiency," and "waste" are *all* just the result of too much "doing." "Don't just do something, *sit* there!"

HOW HEAT WORKS IN MASONRY

Now you've got a good fire going, it helps to understand how the heat of the fire moves into the body of the oven, where you can control it for cooking. Similar principles apply, but in a different way, because now we're dealing with how materials get hot, without burning. Masonry ovens, be they earth, brick or stone, absorb heat a bit like a sponge absorbs water. The process is governed by the principles of:

HEAT TRANSFER,

Heat transfer is like a dance, except that (unlike humans who get warmer as they dance), heat transfer starts out hot and goes to cold. The rate of the dance depends both on the material, and the difference in temperature. The bigger the difference, the faster the transfer (thus the tradition of using small fuel to fire the oven hot and fast).

But the material itself is also very important. Take, for example, your morning coffee and bagel: at 200°F, the coffee is "scalding," but the oven (where you've put your bagel to melt the butter) is just "warm." The temperature is the same, but the feel is different. Why is that?

A GROUP DEMONSTRATION OF CONDUCTIVITY & THERMAL MASS
Bob Carlson, photo

CONDUCTIVITY & RESISTANCE.

Imagine you're a bagel molecule. The room you share with your other molecule friends (your molecular structure) is filled with couches. With all the couches in the way it's hard to move. All your motion (your *heat)*, pretty well stays with you; only rarely do you get up and bump into someone else. So the bagel is a *poor conductor,* because it *resists* heat transfer.

In coffee, on the other hand, not only is the structure denser and heavier (more molecules in the room), but there are also very few couches. Instead of sitting around, everyone is standing, walking, or waving their arms talking excitedly. The excitement is contagious: one person jumps, everyone joggles — low resistance, good conduction. Finally, there's an empty room with no bodies — no material, no movement, minimal heat transfer — a vacuum, the best insulator.

So heat moves differently in different materials. In water or metal, it goes fast and free; in a bagel, it goes slow and circuitous. Clay and cob are full of both molecules and couches, so there's little movement, but lots of bodies which share heat because they're all packed tight. High resistance, low conductivity, with a large capacity for holding onto heat — good for an oven, and a good example of "thermal mass."

THERMAL MASS.

"Thermal mass" combines weight, conductivity, resistance, and the ability of a substance to hold heat. In an oven, it means balancing the amount of heat stored against the amount of fuel burnt. In practice, that means adjusting the thickness of your thermal layer: a pizza oven, which has continuous live fire in it, can have just an inch of mass in the dome, and 4-6" in the floor; an oven used occasionally for limited baking can be 4-6" thick all around; an oven used daily for continuous baking can be 8-12" thick (once hot, it will hold steady heat with little additional fuel.)

INSULATION

Insulation is what keeps the heat *in* your oven, rather than letting it leak out, so the *amount* is important (more blankets make a warmer bed). Insulation *slows* the rate of heat transfer because it resists movement (or conduction). In practice, insulation value *increases* as density *decreases* — i.e., the lighter the material, the better: mud is better than stone, wood is better than mud, sawdust is better than solid wood.

Remember, too, that in a gas or liquid, heat can "flow" by convection, so air doesn't really insulate unless it's trapped. Some oven-builders insulate the hearth floor with a layer of broken glass, but unbroken bottles make more sense to me. They require less overall weight for more trapped air, and you don't have to worry about all those sharp shards when the oven reaches the end of its useful life.

MAKING THE MOST OF MASONRY

The properties of heat and masonry are what make your oven able to hold a nice "deep" baking heat. But getting all that mass up to temperature uses *way* more fuel than you would need to just cook one batch of dough (and much of the heat is lost to the sky, as well as to the masonry). So if you only bake in your oven for an hour or two, the heat that remains *in* the oven will leak off into the ground and air, long after you're happily eating bread and soup.

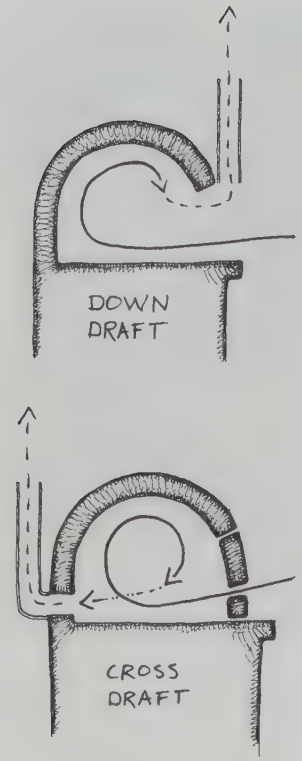
Thus, for sporadic use and small amounts of food, a low-mass Winiarski-type oven (p. 106) may be more efficient. But you can't make it out of mud. Can you make an efficient masonry oven? Well, the answer is "yes" and "no." The oven itself is only part of the challenge. If you bake every day in a well-insulated masonry oven, so the masonry never loses its initial charge of heat, you can cook lots of bread with not very much wood (see sidebar).

So while it's true that masonry ovens waste heat on either end of the heating and cooling cycle, it's also true that a well designed and built masonry oven, with a conscientious operator, *can* be fuel efficient. Even if you only bake once a month, however, you can minimize heat loss (and the labor of getting wood) with maximum insulation and optimal usage — so keep cooking after your bread is done! Or share the oven with your neighbors and friends, and make bake day a weekly party. That's a result of your "making" that can't be measured in pounds, dollars, or BTUs.

TESTING OVEN EFFICIENCY

Alan Scott, a master builder of brick ovens for commercial and home use, not only insulates his ovens, but completely isolates the hearth floor from conductive losses. The best performance he's reported in one of these ovens was 630 pounds of dough baked with 130 pounds of fuel, in sixteen and a half bakes. That's nearly 5 pounds of dough cooked with every pound of fuel (the ratio drops to 4.2 pounds of cooked bread/pound of fuel.) By comparison, in 1999, Dean Still of Aprovecho Institute reported baking 66 pounds of bread with 11 pounds of fuel in a low-mass Winiarski oven (6:1 bread:fuel). [see page 106, and http://listserv.repp.org/pipermail/stoves/1999-May/005063.html]

By comparison, in a recent firing of our home oven, we burnt about 16 pounds of dry wood, cooked 24 pounds of dough, a few pies, a pot of beans, vegetables, heated a gallon of milk for yogurt, and dried wood for the next fire. It helps to be prepared!



FRONT VS REAR CHIMNEYS
The front chimney requires no special firing door, and no chimney damper.

ON CHIMNEYS

In the previous edition, I recommended chimneys to improve draft, combustion, and efficiency. This was based on the observation that chimneys seemed to produce brighter, hotter fires. But I keep learning how much more complicated efficiency is, and am not sure I can still make the same argument. I have also perfected a practical firing door which works as a very short, removable chimney. I find it more useful (not to mention easier and quicker) than building a whole chimney, and perhaps as effective in getting a good fire.

Some want chimneys to minimize smoke problems, but even a tall chimney won't always remove the smoke far enough to solve that problem. Remember, too, that fire is a living thing, and how it burns depends on what you feed it, how you manage it, etc. If your fuel is wet it will smoke, or if you add too much fuel too fast, it will drop the temperature and also produce smoke.

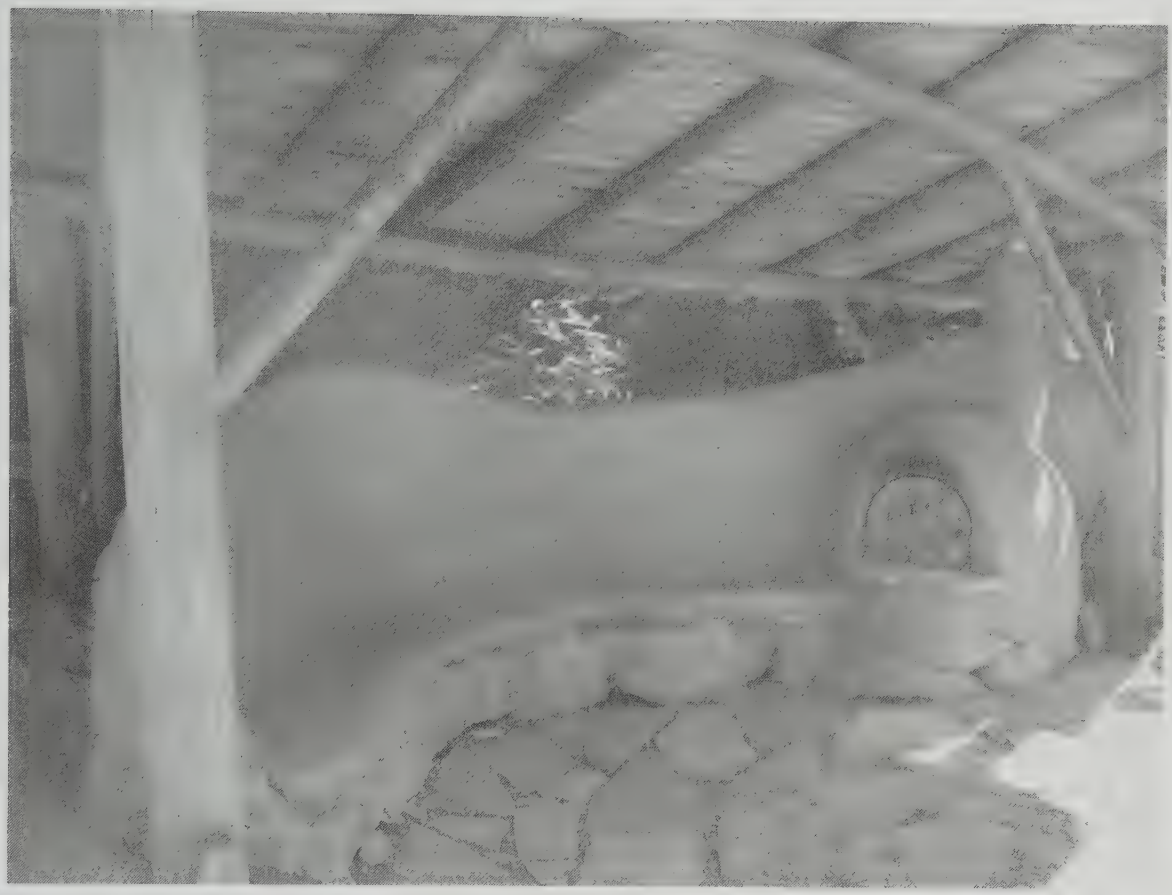
That said, there are situations where a chimney makes sense — indoors, obviously, or in a sheltered spot where a chimney will get the smoke up and out of your way. And of course, if you're sculpting an animal oven, chimneys add drama by giving your beast a breath of fire!

Don't just poke a hole in the top of the oven, however. Heat and air flow follow the shortest path from combustion to exhaust, so a central chimney removes too much heat. Better to keep the fire swirling around in the oven as long as possible before letting it escape.

I've had the best results with the basic "downdraft" design of the chimneyless oven, in which air comes in the bottom of the door, sweeps across and through the fire, rises up with the heat of combustion to roll against the oven roof, and finally sweeps down again and out the top of the door. So I put the chimney directly above the doorway. Rear chimneys work, but mine have burnt too much, too fast. They also require a separate damper to prevent heat loss during the baking cycle.

For a 21" oven, I've found a 4" diameter chimney to be adequate; 6" for a 27" or 36" oven. But you might want to test their performance first with a temporary metal pipe, rolled up metal roofing, clay tile, etc.

In order to work, chimneys need to heat up quickly, so you *can* make them too large or too tall. Alan Scott has suggested that chimney height need not be any more than the depth of the oven. Smooth airflow also helps, so it's good to make smooth and easy curves and bends. Finally, it should heat up fast: use thin metal, or insulated masonry (you might try



OVEN, BENCH, & SHELTER
Built by Pat Henneberry of Cobworks, on Mayne Island, Vancouver, BC, Canada (see Resources for contact info). The overall design would work with a front chimney, which has the advantage of needing no damper.
Rogmans, photo

making "snakes" of straw dipped in thick clay slip, and coiling them up and around, like making a pot).

For interior chimneys, check your plans with your local code official or fireplace mason, and ask plenty of questions. You don't want to risk a chimney crack that could create flammable soot buildup or other hazards.

Decorative chimneys for sculpted ovens are easy with tin cans placed end-to-end, and sealed with cob. I've also used cardboard tubing, which burns out (beware long chimneys, especially if they bend. If the flue isn't hot and fast enough, paper cores can smolder and curl, blocking draft and creating a removal challenge).

If you build a chimney in front, build it out from the door so that when you close off the oven, you've closed off the chimney too. Make sure your chimney support structure is big enough to allow you to maneuver your baking door in and out. You may want to make a metal firing door that will allow you to better control airflow into the fire (see pp. 46,47,68). An oven with a chimney will burn just fine without one, but a firing door (with vents) allows greater control over air flow. In a pinch, use a piece of sheet metal or stacked bricks.

A FEW OTHER PRINCIPLES

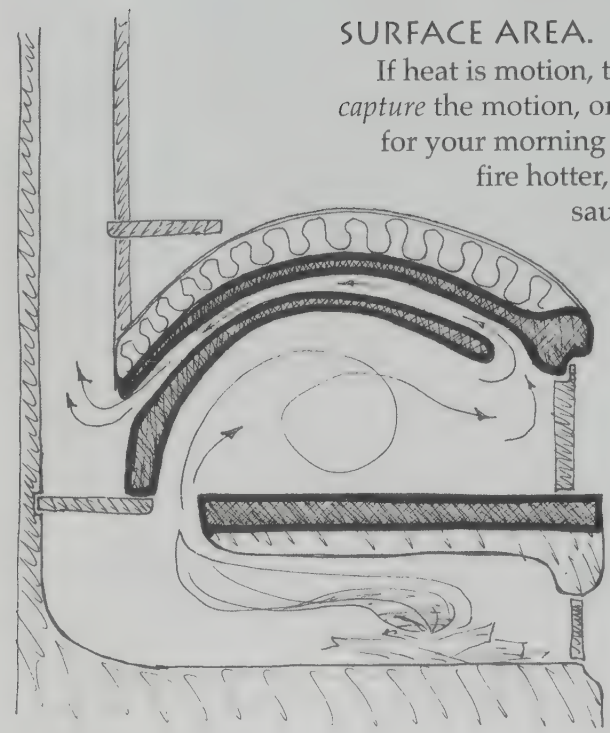
These seem worth mentioning in a general way for how they help determine the workings of heat and ovens:

SURFACE AREA.

If heat is motion, then an oven is effectively a means to *capture* the motion, or energy of the fire. Think of boiling water for your morning tea: you're in a hurry. You can't make the fire hotter, but you can choose a tall, narrow saucepan or a squat kettle. Clearly, the wide bottom of the kettle exposes more water to heat, so you use that. By the same token, once you've boiled the water and made the tea, you want to keep it hot as long as possible. So rather than pouring it into a shallow bowl, you choose a round mug deeper than it is wide.

Maximizing or minimizing surface area maximizes or minimizes heat transfer. But how might you maximize heat transfer on the inside of an oven, and minimize it on the outside? Obviously, it wouldn't make sense to build a shallow oven 6 inches high and 10 feet in diameter (the fire would choke, for one thing), but you could increase the inside area by corrugating the surface, and minimize the outside area with a smooth, polished plaster.

More sophisticated ovens have a complex array of flues and vents which allow nearly all the heat of the fire to be absorbed into the masonry before it goes up the chimney. And there's the low mass, hi-efficiency Winiarski rocket oven (see p. 106), which uses a fast burning "rocket stove" and convoluted vents to wrap a metal drum with continuous heat.

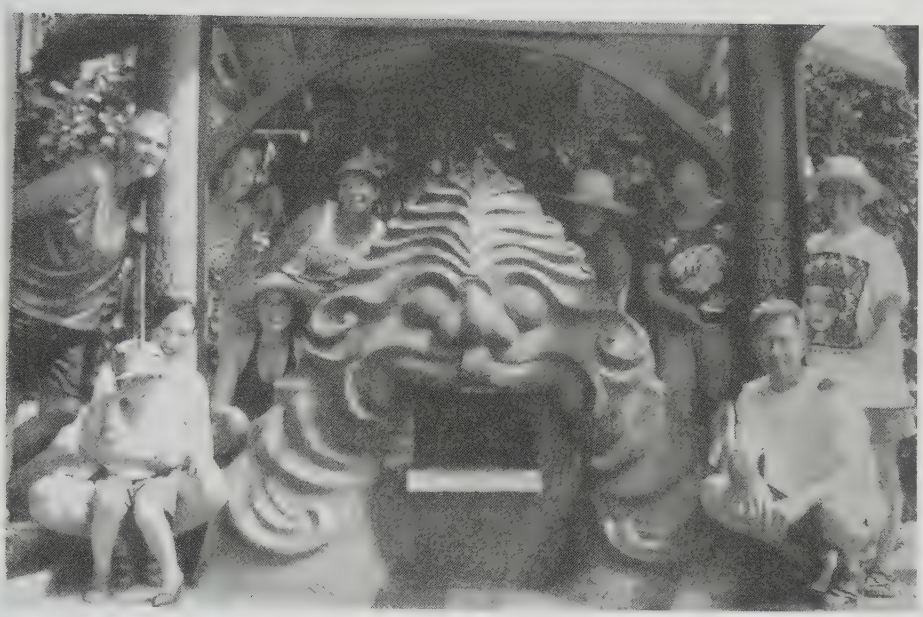


MORE SURFACE AREA MEANS MORE HEAT GAIN

To maximize surface exposure to heat, this design effectively wraps the whole oven in the hot exhaust from the fire (below the floor). The narrow flue is basically a gap between two shells of thermal material — complicated to build. In addition to the double shell, it also requires sliding baffles and multiple doors to manage or stop airflow once the oven is hot. (Drawing after a design by Paul Mery.)

DRAFT

Draft is an upward current of air created when buoyant light air draws heavier air upwards (also called the chimney effect). Warmer air is more buoyant, so it floats, or rises. When you enclose a column of warm air in an actual chimney, you effectively concentrate the draft effect into a smaller area, increasing the...



BALI-INSPIRED GREENHOUSE OVEN
built by the author and workshop participants over two days, in Portland, OR. The chimney leans back at an angle. In winter, residual heat benefits the greenhouse plants.

RATE OF DRAFT.

When you increase the height of a chimney, you increase the rate of draft because you've increased the pressure difference between top and bottom. Large industrial incinerators have tapered chimneys to reduce the total amount of stuff in the column, thus reducing the weight of air above, and the pressure it exerts downward.

Rate of draft determines how much oxygen the chimney pulls into the fire, which in turn affects how it burns. So chimney height affects how much air can be "pulled" through a chamber of a given size — whether it's an oven, kiln, or house. A home bread oven is small enough that this will be a minor consideration, unless you're trying to increase surface area with a more complex oven design.

PRESSURE & TEMPERATURE

Air, like water, has weight, and weight creates pressure. Temperature affects pressure because it determines how much air will fit in a given space. On the scale of a house, high ceilings, open stairways, or lots of (kitchen & bath) fans and vents, draft and pressure differentials can interfere with how a chimney draws and whether or not your indoor oven (or fireplace) burps smoke into your kitchen or living room. (On the scale of a whole planet, you can get weather.)

CHIMNEYS, VENTURIS, & DAMPERS

A chimney and firing door with vents can increase turbulence and improve combustion by providing a "Venturi effect." You see this clearly in a garden hose when you reduce the size of the opening to make water comes out faster and at higher pressure . The same applies to air: given the same draft or chimney size, the smaller the opening to the oven, the faster the air will flow. And the faster the air flow, the more turbulence and mixing of fire and oxygen. In a hose, however, pressure pushes the water *out*. In an oven, chimney draft pulls air *in* — so to increase the effect, you reduce the size of the *inlet* rather than the *outlet*.

MOBILITY IN MEDIEVAL TIMES

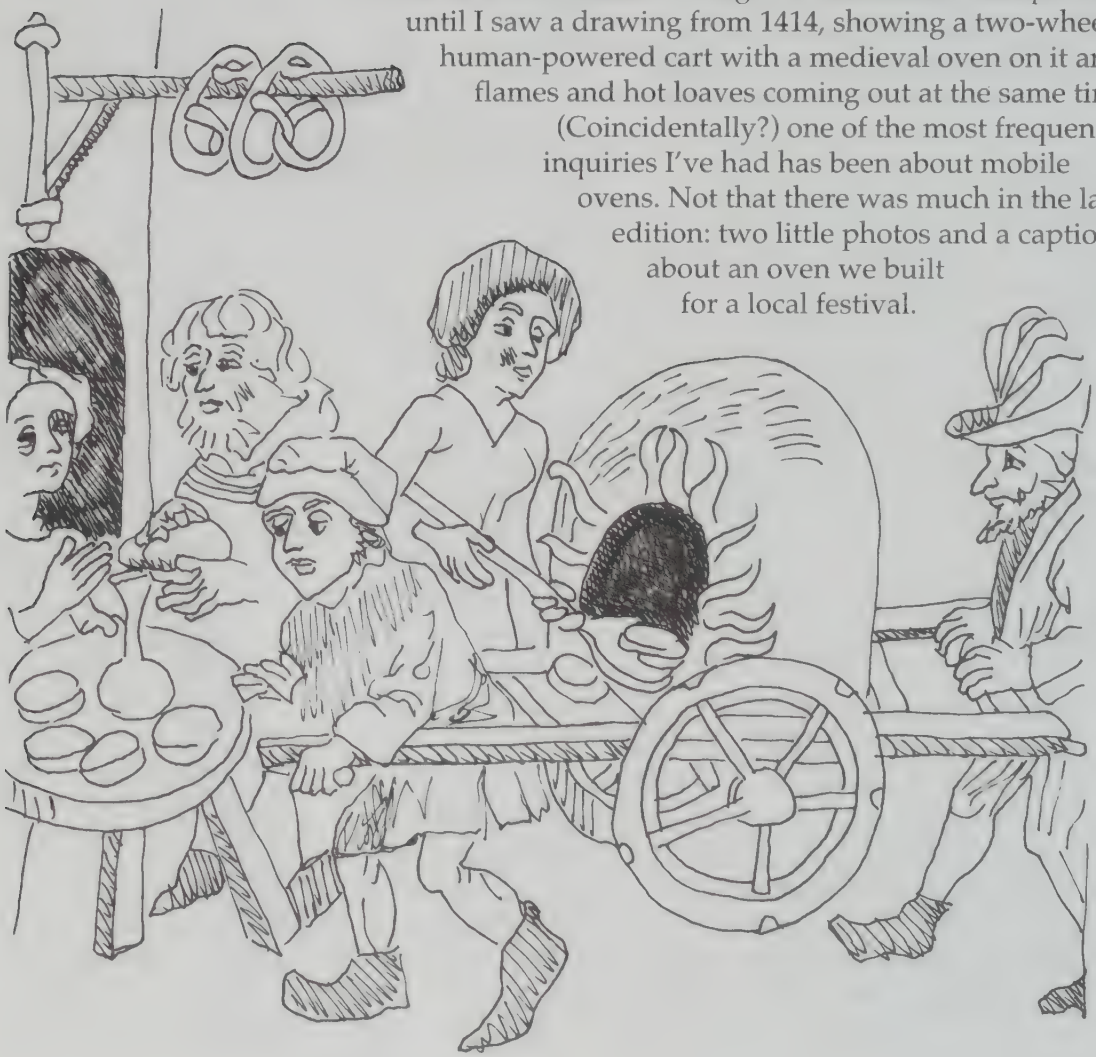
A medieval scene from 1414. Note the (edible?) "sign" over the bakery door. Technical specifications not included. From a drawing in Pierre Delacrétaz' classic *Construire un four á pain*, Editions Cabédita, 2000.

CHAPTER SEVEN: ANCIENT DESIGNS & NEW EXPERIMENTS

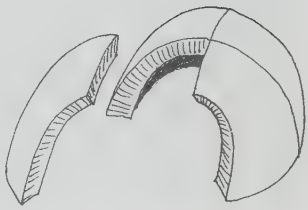
Some of the following are variations I've tried, and others seem like ideas worth passing on. If you try any of them and get interesting results you'd like to share, I'd love to hear about them. Perhaps they'll find a place in a future edition, or in a web-based archive. As you'll see below, the web archives already include community and mobile ovens.

MOBILE OVENS

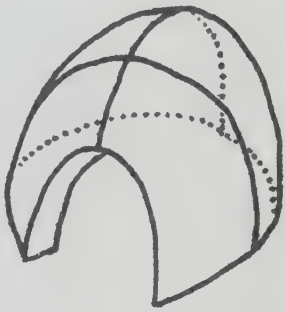
When we met, my wife Hannah had been dreaming of an oven on a bike trailer. I thought it sounded a bit impractical until I saw a drawing from 1414, showing a two-wheeled, human-powered cart with a medieval oven on it and flames and hot loaves coming out at the same time! (Coincidentally?) one of the most frequent inquiries I've had has been about mobile ovens. Not that there was much in the last edition: two little photos and a caption about an oven we built for a local festival.



That oven was *not* made of mud! I figured that no matter how good a trailer we could build, the high-frequency road vibration would shake it apart, probably sooner rather than later. So we built it with refractory cement, which (unlike portland cements) will withstand high temperatures. Look for LaFarge, Fondue, Lumnite, or "calcium aluminate" cement. (I later met someone who built a massive earthen oven on a trailer, but he was doing repairs before a year was out.) We did several gigs with it before deciding that catering wasn't for us. The base got damaged later, so the oven was finally scrapped.

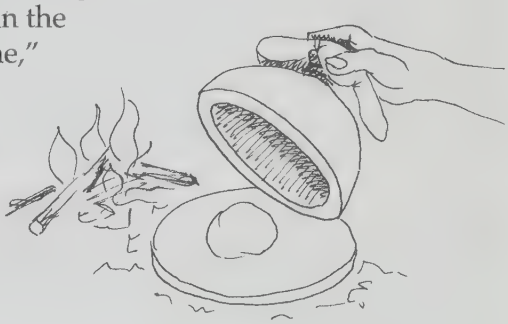


Now I think it would make more sense to build a new oven for each site, the day before the event, so people could watch, or even take a workshop. Or I'd copy Mexican festival bakers who transport bricks and mud and build a "new" oven at every stop.



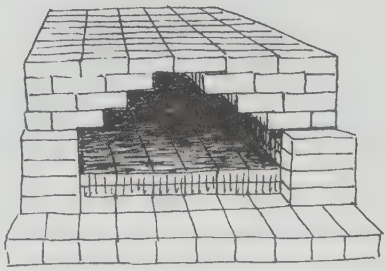
Using a sand form (and refractory cement instead of mud), I did build a simple four-part oven shell (diagram at right), which I could move and (dis)assemble at different sites. The trick is to make four quarters that all fit together. I used thin sheet metal pushed in the sand as dividers, and built layers as for a mud oven. Beware: even in quarters, the pieces of a small oven with a 2-3" thick shell are heavy!

A cloche is a thick clay pot. Ancient middle-easterners heated it in the coals and inverted it over a piece of dough on a tile griddle. The same tradition that lives on in the cast iron "Dutch oven," and the popular "la Cloche," which you heat up in your conventional oven to imitate a one-loaf masonry oven. Similarly, a "clome oven" was a clay pot of the right dimensions with a door cut into one side. It was portable, but was also often permanently built into a chimney or kitchen hearth. If you could find a unglazed ceramic planter of the right size, perhaps you could use a masonry blade to cut a door in it, and add a layer of mud for extra mass as needed…?



A SIMPLE STACK OF BRICKS

Peter Schumann has been combining political theatre with site-built ovens and good bread since the 60s. He says that art should be like bread, affordable (and nutritious) for everyone. His Bread and Puppet theatre has made ovens, bread, and art all over the world. The sketch shows his approach of dry-stacking bricks so their weight holds them in place. I've done similar things with fewer bricks and a bit of mud for mortar. You could even make your own bricks. And your own puppets. And your own art….



LONG HAUL OVEN:
This auto oven, made of mud, belonged to a guy I met at a natural building colloquium on Vancouver Island, in BC. I never did get his name because I was so busy admiring this tiny oven, which was vented out the side of his van, and had a high temperature glass window so he could watch the fire. He said he used it for breakfast biscuits. Note the bit of stick inserted in the oven door for a handle; the hole doubles as an air intake.

SHORT HAUL OVEN:
Made by a workshop participant who not only adapted the basic design to a steel utility cart, but also made a neat separate firing chamber under the hearth floor. Above is mud, below, brick. The slot that's just visible at the far left edge of the left hand photo is where the heat of the firebox vents up into the oven chamber. Reports were that it performed well. *(photos & inspiration: Roger Bell & daughter)*

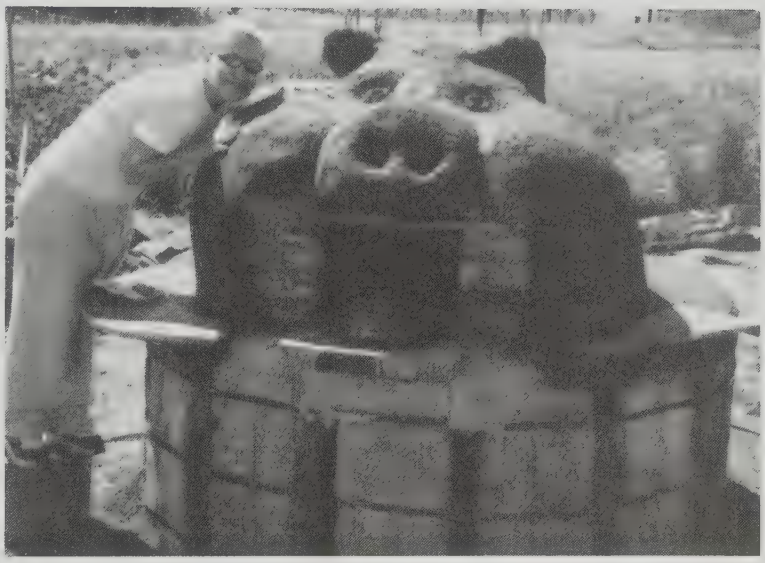
PIZZA TO GO:
Built by the author out of refractory cement to provide pizza for a summer festival, the box was suspended on motorcycle shocks, a solution inspired by Hannah, and built by a welder friend, in a lot more time than it took to build the oven! We cooked 500 pizzas in two days. After we scrapped the oven, a Waldorf school got the trailer, but then it was stolen! *(Ann Wiseman photo at left)*

"REAL" TRAILERS FOR DIE-HARD DRIVERS

If I haven't convinced you to build or assemble your oven on site and make it a social event, or if for whatever reason you must go the trailer route, the handprintpress.com archives feature Dan Wing's technical notes on building a good, safe trailer that will add as little as possible to the risks we already run on the highway. Dan has a well-travelled trailer-oven, and is co-author, with Alan Scott, of *The Bread Builders,* a bible for brick-oven, hearth-bread bakers.

COMMUNITY OVENS

The hearth is common ground. Ovens, fire, and food attract people, celebration, and stories.... I suppose it's no surprise, but what I hear from readers, and from other folks, confirms the power in that common kitchen combo — and all the stories seem to contain an element of surprise. Perhaps it's like discovering edible mushrooms on your front lawn. When delicious mysteries reveal themselves to you, in the heart of your own home, what is more natural than surprise and gratitude?



PIG IN A GARDEN: Desirée, above, designed and, with a score of other kids, helped build the pig oven for a community garden in Corvallis Oregon (you can just make out her model sitting in the dark shadow of the big pig's mouth). Food from the garden is donated to local shelters, and the oven fed neighbors and other folks for summer gatherings, fundraisers, etc.

The color section includes more photos and stories about various ovens and their communities, but there is far more than I can fit in this book. In addition to the photos and stories I have printed here, I've posted these longer and/or more specialized items at handprintpress.com:

- A wonderful paper called *Cooking With Fire in Public Spaces,* which includes advice and stories about the process of "getting approval" for a public, wood-fired oven in a Toronto city park. *"Cooking fires are a strong tonic for introducing neighbourliness into parks. They hearten people and help them enjoy one another...."*
- http://www.dufferinpark.ca; for a virtual tour of Toronto's Dufferin Park, including several community ovens, and the above mentioned paper.

URBAN MUD

Beth Ferguson led more than 50 community members in building this turtle oven for a community garden in an an inner-city neighborhood of the Bronx, in New York City. Materials were recycled or re-claimed urban "waste." The oven provides a central focus for the garden, and great food.

OVENS IN PUBLIC SPACES

from *Cooking with Fire in Public Spaces*, by the Friends of Dufferin Park (www.dufferinpark.ca): *"Once or twice a week in the summer it's an open oven, when anyone can come and buy a lump of dough and some tomato sauce and cheese, bring their own toppings and make lunch. Often there are seventy or eighty parents and young children coming to make their lunch. Getting your lunch like this takes much longer than ordering a slice from the pizza place up the street. But people tell us speed is not the point. Perhaps they've come to meet their former prenatal class here, all of them now with six-month-old babies, and they're all spread out on three big blankets. Or they've just arranged to meet one friend and spend an afternoon off work in the sunshine, talking and watching the children run around the park. Or they've come on their own, new in the neighbourhood, hoping to meet some of their neighbours."*

- A description of, and links to Portland, Oregon's *City Repair Project*, which uses earthen building and persistent neighborliness to restore human fellowship as a core value for healthy, democratic cities. Food, the communal hearth, and neighborhood ovens are essential tools for repair.
- Discussion of EPA regulations of particulate emissions and how wood fired ovens should be treated in comparison to box stoves and fireplaces, from the yahoo brickoven group
- http://groups.yahoo.com/group/brick-oven/; a listserve for wood-fired oven makers and users, with archives

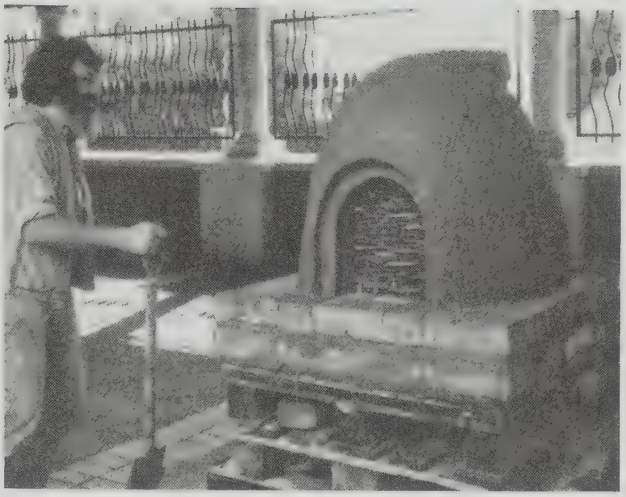
I'll continue to use the site to post useful and/or interesting information and links.

2-CHAMBER OVEN

One of my (many) home ovens was a two-chamber design with a separate fire box below the oven. My goal was to create a "secondary burn chamber" in the oven, where a second blast of air would ignite gases and unburnt fuel (smoke). Good "secondary combustion" makes for a cleaner, more efficient burn, and more heat from the same fuel. I also wanted to direct flue gases around the outside of the thermal layer to get more heat into the oven before it went up the chimney. And finally, a separate firebox means no coals (but still some ash) on your hearth.

I tried the design twice. It burnt well, but greedily. The main problem is that the "secondary" air must be pre-heated for good combustion. This means drawing it past the hot walls of the primary firebox through a system with lots of surface area to get temperatures up to 6-700°F. Fancy box stoves do it with steel pipe wrapped all around the firebox (hard to do that with mud). The same challenge applies to wrapping the exit flue around the outside of the thermal layer for maximum heat transfer there too. The flues must be precisely sized, to match

draft, and smooth, to minimize back pressure. Finally, you need tight dampers, doors, and controls. Page 96 shows a commercial design made with specialized materials and techniques. Roger Bells' version (page 100) is simpler and easier, but doesn't produce a true secondary burn. Candy Vanderhof's oven in the color section is an ambitious design that hadn't been thoroughly tested at press time — but it does incorporate a solar calendar and tea station!



BASKET OVEN
The beautiful wicker basket is burnt out with the first fire. Oven builder Bernard Graves (in photo) is director of The Hiram Trust, which "fosters the ethos of education for sustainability" in Stroud, UK. See Resources for contact info.
E. Holliday photo.

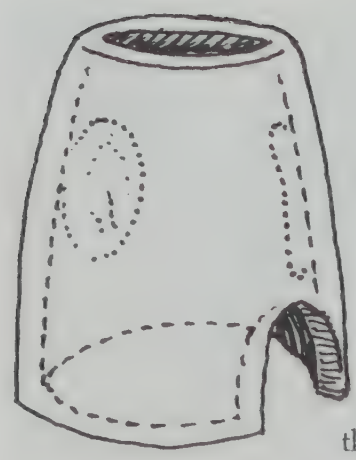
ALL CLAY OVENS (CANADIAN TOO)

Many ovens, "Quebec style" as well as the rounder "beehive" shape, are all clay. There are advantages: while a sand-clay mix is denser than pure clay, and able to store more heat, sand can loosen, and "spall," or fall out. If you don't clean the floor well, you could get sand in your bottom crusts. (Clay can crack and spall too, but even when it's oven-fired, it's usually softer than a grain of sand and not such a risk to unsuspecting teeth.)

The "all-clay" ovens I've made have used homogenous subsoils, with lots of silt, but no sand (the silt helps minimize shrinkage). My mix is malleable enough to make a hard, solid ball in the hand, but not so soft as to squish between the fingers when squeezed. It compacts well, becoming solid and hard, instead of splooging out sideways. Traditional Canadian-style ovens control shrinkage cracking by adding hay to what sounds to me like a much purer clay. They also mix and apply it quite wet.

The little oven I made for my folks' "meadow fest" was pure subsoil dug it straight out of a hill, packed directly around the form, and immediately whacked solid with a 2x4. I fired it dry, filled the cracks, and we made pizza the next day! (See photos, p. 14.)

The commercial oven I made for Intaba's restaurant replaced sand with "grog" (firebrick made sabulous by grinding.) Grog has excellent thermal mass, but it's also expensive (it's possible to make a thin shell with the grog mix, followed by a regular sandy mix). Next time, I'll make the mix richer in clay, and apply a heavy binder coat of waterglass as soon as the oven is dry.

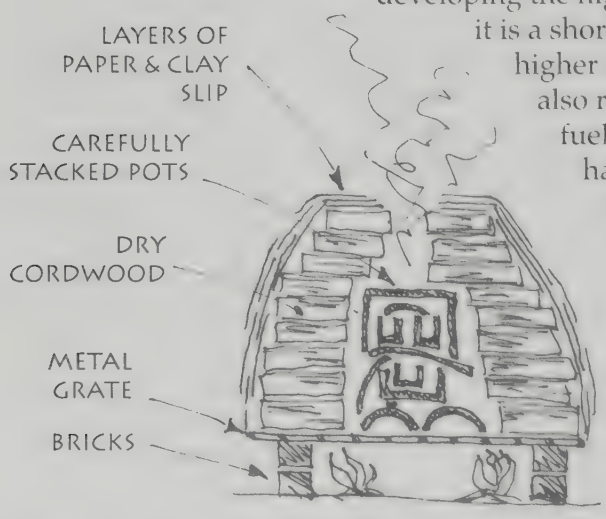


A BASIC TANDOOR DESIGN

"TANDOORS," POTTERY KILNS AND OTHER USES FOR OVENS

Tandoor, tannur, tennur, tandir, tandore, tamdir all mean, simply, "oven," in various middle eastern languages. The design is basically a clay cylinder, or chimney, with a hole in the base for feeding the fire. The baker slaps his flat bread on the smooth, vertical walls, or sometimes cooks on a griddle placed on top. (see photo, page 13) According to Jeffrey Alford and Naomi Duguid, the design originated near or in what is now Iran. The traditional units now being exported are apparently made with a mixture of native building soil and manure. Cob or "clay-wattle" coils would probably work too.

Interestingly, the tandoor design is very similar to many traditional kiln designs — much better than a mud oven for developing the high heat you need to vitrify clay. In effect, it is a short, very hot chimney that will attain much higher temperatures than an enclosed oven. It also readily lends itself to stacking layers of fuel and pottery. In a mud oven, on the other hand, combustion and heat are limited by the size and location of the door/vent/air intake — not to mention the difficulty of stacking fragile pots and fuel in a confined space.



The Hiram Trust in Stroud, UK, integrates landscape, craft, science, technology, and environmental education. Their designs include lime and charcoal kilns. See Resources for contact info, and for an article about a mud kiln made around hay bales that reached 1700°F, (Eddie Starnater, "Constructing an Earth Kiln").

Southwestern pueblo and Oaxacan potters still use "pit kilns," which are probably the earliest design: just fuel and pottery strategically stacked in a shallow hole in the ground, perhaps with shards of old pots lining the edges to contain the fire.

Along these lines, an ingenious design from the UK combines pit fire and chimney design (above) by a brilliant use of clay slip to coat and bind glossy Sunday magazine paper into a quick, effective clay chimney. Interestingly, what makes such paper glossy (and thus effective) is a very fine layer of — clay! Leave a small hole at the top, and light a fire underneath. When the smoke goes from black to white, widen the hole at the top to increase draft and combustion. Let cool, and see what's become of your pottery! (The "paper" shell can retain it's form through to the end!)

BRICK OVENS

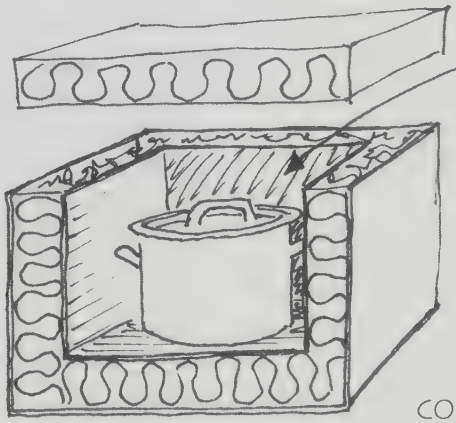
If you want to buy bricks and mortar (you could make your own! see page 2), design options include: Alan Scott's super-insulated design (ovencrafters.net); Fornobravo.com's free plans for a typical Italian brick oven; plus lots more on the web. Yahoo.com's brickoven group and fornobravo both host web-based "communities" where people share oven-building experience. Wood fired brick ovens are common in other countries; in Italy, apparently, you can pick up inexpensive do-it-yourself models at any home supply center. May I say it again? "Bigger (and more expensive) isn't better."

BRICK OVEN BIBLE

The Bread Builders, by Dan Wing and Alan Scott, is a complete reference on the science and art of baking in retained heat ovens. It includes recent research into yeasts, bacteria, and the fermentation of dough, and puts it into context with visits to well-known professional bakers. It also includes plans for building a professional-quality brick oven and instructions for using it. Worthwhile for fans of mud or brick.

OVENS FOR THE WORLD?

The rising price of fossil fuels may finally make all of us more aware of severe fuel shortages and accompanying deforestation and desertification. Our choices are part of a larger picture, especially, I think, for those who leave wealthy countries to try and help poorer ones. Fuel is not the only issue. Cooking technology is part of complicated cultural patterns. Is it good to build a pizza and bread oven in a place where rice is the staple crop? Will new or different technology hurt or help existing ways of life? How can a visitor know? While such questions are beyond my expertise, I find myself asking them, especially with regard to ovens that have been built with the help of this little book. I hope the following might be useful as well.



IMPROVE INSULATION BY FILLING EXTRA SPACE WITH AN OLD SWEATER

FIRELESS "HAY BOX" & SOLAR OVENS

The quickest solution to efficiency and pollution problems caused by fire is simply to snuff it out — no fire, no problem! A "haybox" effectively does that by applying the principle of insulation — and it requires neither hay, nor box!

Boil a pot of rice for a few minutes, and wrap it up in a sleeping bag. The insulation holds the temperature of the rice and water long enough to finish cooking the rice, and in an hour or three, you'll still have to blow on the rice to eat it! (If it isn't done, boil and wrap again.) In general, a 4-quart pot full of boiling water and grain or beans provides enough thermal mass to cook — although, obviously, the more mass the better.

HAYBOX COOKERS TO CONSERVE FUEL & FORESTS

Many people are working to address fuel shortages and cooking needs in poorer countries. Aprovecho Institute has been developing haybox cookers and solar ovens, as well as the Winiarski rocket oven (next page, see also aprovecho.net, Aprovecho Inst., Cottage Grove, OR 97424).

THE RENEWABLE ENERGY POLICY PROJECT (REPP), was formed in the mid 90s by the Energy Foundation and DOE, offers info and on-line discussion groups at www.repp.org. Their stove group archives are at: http://listserv.repp.org/mailman/listinfo/stoves. ß1612 K Street, NW Suite 202 Washington, DC 20006

Clay and cast-iron pots are better than steel, which is better than aluminium. You'll also learn by experience how long to boil things before you insulate.

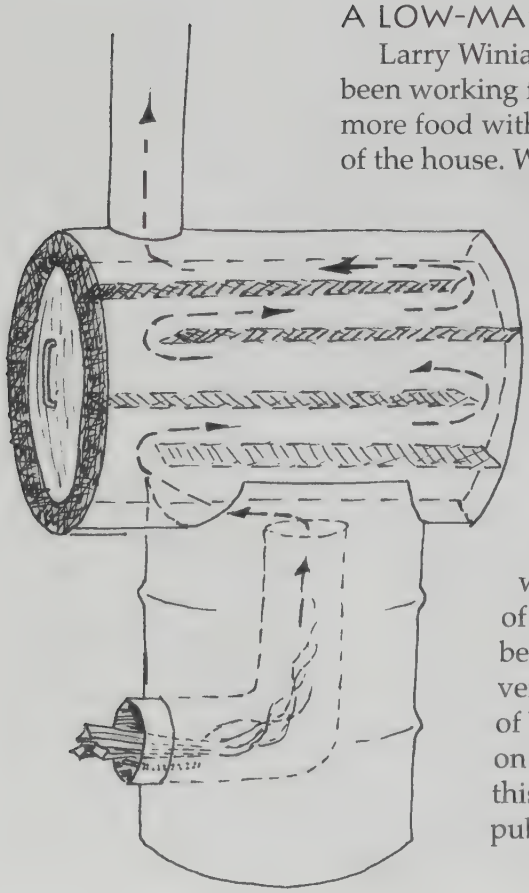
The "hay box" itself is just a convenient and simple way to "package" the idea, especially where there are no sleeping bags. You'll need two boxes, one at least 4 inches smaller than the other, with about 2" of straw, hay, or other lightweight, insulating material between them. Wrap an old sweater around the pot, cover with an insulated lid, and you're done!

It's easy with rice, beans, and vegetables; we've even used it to finish cooking slow-cooked steamed breads! For meat dishes, be very careful to keep temperatures high enough to avoid breeding salmonella and/or other harmful bacteria.

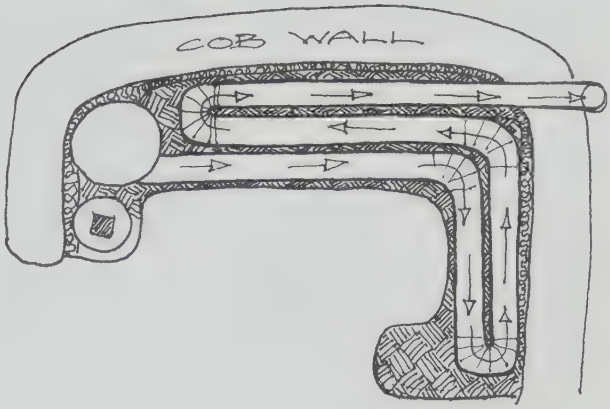
A solar oven is basically a similar box with a glass lid and black interior. Put it outside on a sunny day, lean it to catch the sun's rays as directly as possible, and you can do all kinds of cooking in it. Dark surfaces absorb the radiant energy of the sun's rays, and an insulated box holds the heat. There's lots on the web; solarcooking.org is one place to start.

A LOW-MASS, HIGH-EFFICIENCY "ROCKET OVEN"

Larry Winiarski and Oregon's Aprovecho Institute have been working for years to people in poor countries to cook more food with less fuel, while also getting harmful smoke out of the house. Winiarski's "Rocket Bread Oven" (left) is an ingenious application of basic principles, and made from old metal drums or other materials available on site. The "rocket" is basically a short hot *(insulated!)* chimney with a horizontal tube through which you feed the fuel (not so different from a basic tandoor design).



Heat is transferred from fire to oven chamber by a series of passages arranged in the gap between two drums. The passages are made using simple sausages of foil-wrapped fiberglass insulation. In this way, most of the heat from a very small amount of fuel can be transferred to the bake chamber to bake bread very efficiently (in one instance, they baked 66 lbs of bread with 11 lbs of wood!) Much of the work is on the website, with photos, and instructions for this and other simple stoves are included in their publication called "Capturing Heat."



HI-MASS, HI-EFFICIENCY "ROCKET" HEATER FOR THE HOME

While you could make an indoor oven, and while it would provide some heat for your home, most of the heat from an oven fire would go right up the chimney. This is also a shortcoming of most wood-stoves.

The above-mentioned "rocket" design, on the other hand, combines efficient combustion with the effective heat-storing properties of cob to make a lo-tech, lo-cost variation on the classic "masonry heater" (also called the "Finnish fireplace," or "Russian flue"). All these designs burn hot and clean and direct hot gases through vents wrapped in dense, heat-holding material, to keep it in the house, where you want it.

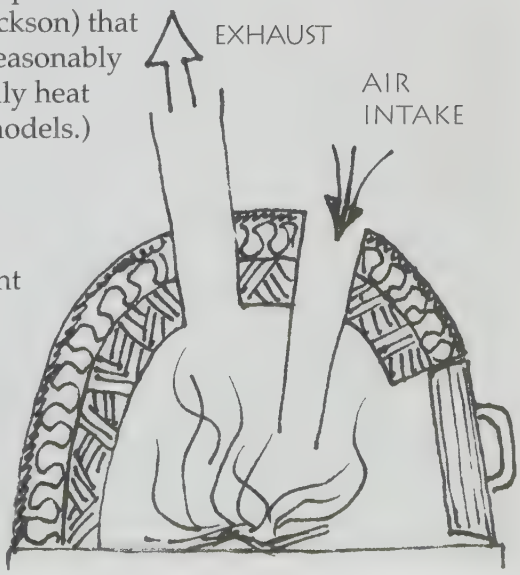
While a masonry heater is a major project involving complex plans and skilled brickwork, the rocket stove applies the same principles to earth-masonry in a way that almost anyone can fabricate their own heater at very low cost and with minimal technical expertise. Ianto Evans, one of the founders of the Aprovecho Institute, has recently published a book called *Rocket Mass Heaters* (with Lesley Jackson) that provides clear, step-by-step directions that any reasonably handy person can follow. (I comfortably and easily heat my home, office, and shop with three different models.)

ROCKET MASS HEATERS FOR THE HOME

The stove itself is contained in the two metal barrels at the far left of the leftmost drawing. The other drawing shows a flue routed through a high-mass bench to capture and hold heat in the house. Copies available from Cob Cottage Co., POB 942, Coquille OR 97423, cobcottage.com, or rocketstoves.com

EXPERIMENTAL "ROCKET" OVEN FOR HI-MASS & HIGHER EFFICIENCY

The sketch illustrates an interesting experiment that applied "rocket" principles to an earthen oven (Jim & Tyra Arraj; innerexplorations.com). Intake and exhaust routes would be removable metal pipe; plugs would seal the openings for baking. A fireproof door would be shut for firing. Cob Cottage Co. has experimented with a similar design that directs heat in at the side and vents through an open door.



Claudia Prevost runs the Buena Vista House Café & Lodging near Salem, OR. Her husband David built the oven. Friday night is pizza night.

Raven guards the doorway of Dennis Kuklok's Haida-inspired oven; it rests on a piece of huge steel pipe from a defunct, local waterworks.

CHAPTER EIGHT: TROUBLE-SHOOTING & FOLLOW-UP

The most common questions are covered in the text at the appropriate stage. Other things that might come up are addressed here. If I've missed something, feel free to contact me through the publisher, by mail, or on the web: www.handprintpress.com.

FIRING & USING YOUR OVEN

I can't seem to get a good fire going

Is your fuel dry? Is it small? Re-read chapter four, on using your oven.

Is there enough air space? Remove some fuel. Move it around a bit. A low door can also constrict airflow and choke the fire — cut it higher.

Is a breeze interfering with airflow into and out of the oven at the doorway? Make a firing door (pp. 47, 69), or try using spare bricks to make a temporary one.

Small ovens especially work best with small fires and small wood; start close to the door. When it's going well, push it back — and then limit the amount of new fuel you add.

Once, when an oven with a front chimney seemed to be burning poorly, friend Jason suggested punching a small hole in the back, opposite the door, to improve airflow. It helped! When we baked, we plugged the hole with a stick.

I built by the book, but it won't hold heat!

Your oven won't perform well until it's *all* bone dry, right down to the bottom of the floor insulation. If you built all the layers one after the other, it may take weeks of drying or multiple long, small fires before all the water is driven out.

Otherwise, keep your fire burning bright. Re-stoke frequently. Leaving it to burn just coals creates cooling drafts that may remove more heat than they add. Fire it longer.

The bottoms of my loaves burn

Are you impatient? Soak the oven longer. Make pizza or pita bread. A pan of water on the hearth can cool it down fast.

If the floor has hotspots, move the loaves around after the first 5 or 10 minutes, or bake on upside down cookie sheets.

Burnt isn't always bad. Charred bottoms peel off (when cool) to reveal intensely caramelized, chewey bits of flavor.

HOW LONG DO THEY LAST?

It all depends: "how long is a piece of string?" The Canadian-style clay ovens at the American Flatbread Company have been in nearly continuous use for about 15 years, with minimal decay. Some commercial brick ovens have needed several re-builds in the same amount of time. The variables that determine the life of your oven include the kind of material you use (both sand and/or clay), how you use the oven, how hot you fire it, and whether it's in continuous use or constantly cycling from hot to cold. Stress (in the form of drastic or repeated temperature change), will shorten the life of any oven. If you want yours to last, *don't* spray water into it, or wet-mop the hot hearth bricks to cool them down.

I can't get nice, brown, crisp bottom crusts on more than 2 or 3 pizzas.

Three things insure adequate floor heat for production pizza: proper firing (chapters four and six), thermal mass, and insulation. If you determine that you need more floor mass, try adding another layer of brick or soapstone. (A higher floor may require a higher door too, or a chimney.) Finally, if you didn't insulate under the hearth floor, you may be losing too much heat to the foundation. Not much to do about this but re-build. The second time is quicker and easier....

What else can I cook in the oven?

Everything! Proceed as with a conventional oven (unless you're using live fire), and expect slightly faster cooking. You can also broil steak, fish, or veggies with a small fire in a cold oven; just turn or stir as needed (a hot fire in a hot oven is much faster; adjust times). Cook greasy or sugary foods in a pan, since residue between the bricks can cause heaving and other problems. Oven canning is common in the UK and other countries — and used to be here. Though it seems to be frowned upon now, we've had good results. I look to hold temperatures of no less than 250°F for at least 30-60 minutes, so things can boil as long as they'd boil in a water bath.

FIRE & BALES

Sparks and high heat aren't the only fire hazard to beware of. Straw bale walls that get wet can ignite simply from biological activity (composting). If your oven insulation and/or plaster butt up against the bales, the steam from a drying fire can be driven into the bales (even if the oven is a "safe" distance from the wall). That moisture, gently heated by the drying oven, can make for some impressive microbial activity. I know of at least one small oven that actually caused such a fire. Fortunately, the bales were plastered and the fire didn't progress quickly; so it was easily exposed and quenched. Still, it's a real risk worth noting.

Can I use my oven to fire pottery?

Well, yes and no. See page 104.

Will the outside get dangerously hot?

This depends on the thickness of the oven walls, how long you fire it, and how much insulation you use. Even in continuous use, the exterior of a well-insulated oven shouldn't be too hot to touch. Yours may be different (see sidebar). As a guideline, consider that code for interior fireplaces specifies a 2 inch air space between a chimney and any combustible, and 9 inches of space between an oven wall and combustibles.

Can I use an electric element? or propane?

One reader tried a 3000 watt range element, but said it never got up to temperature, even after 8 hours. A nichrome kiln element might work, but like a kiln, I imagine it would perform best in a channel, to increase the surface exposed to heat. That gets complicated. Also consider that electricity is typically a very inefficient way to generate heat: you lose

energy when you convert heat to current, and again when you convert current back to heat (unless you have cheap off-peak rates from hydro-plants).

Gas is inherently *much* more dangerous than wood. One reader warned that he'd been burned in an explosion when he re-lit his burner in an oven where gas had accidentally accumulated! While it may be convenient, I've also heard that it doesn't provide the same "deep," long lasting heat that wood does. If you're serious about this option, however, *The Bread Builders* addresses it in more detail; or ask a ceramics or propane supplier about burners for high heat output.

CONSTRUCTION QUESTIONS

Can I quick dry my oven? (In other words, when can I light a fire?)

I have built and fire-dried ovens on the same day with just minimal and harmless cracking (which might have occurred anyway).

My oven is cracking!

Cracks are usually cosmetic. Initial drying can cause shrinkage cracks. Some soils shrink more than others, as do mixes with a low percentage of sand. Adding sand or fiber (hay, straw, manure, etc.) can help. In all-clay ovens, some cracking is probably unavoidable. Removing the sand form may help ease it (be sure your oven is dry enough). Slow-drying helps (cover it with a heavy cloth). Cracks, large or small, can be filled with fresh material (from the outside). In addition, masonry expands when hot; something has to give. No material is immune to thermal shock. Expansion cracks can, however, help you determine the level of heat in your oven. The bigger the crack, the hotter the oven!

EMERGENCY!
Most cracks are smaller than these, which were due to a very clayey building soil. The builder reported that *"we patched the cracks, put on two more layers and... pulled the first pizza out of the oven last night...simply amazing."*
Tim LaBarge, cracks & photo

Can I use vermiculite instead of perlite for insulation?

Compared to perlite and pumice, vermiculite is soft and quite squishy. If you use it to insulate under the floor of your oven, you'll need to mix it with clay slip and let it dry hard before you build on it. For non-weight-bearing insulation it's fine. Use a dust mask.

SAFETY NOTE:
NEVER GO IN YOUR OVEN ALONE:
As with any enclosed space, have someone nearby if and when you repair the inside of an oven, especially if you're going to have both arms or your whole upper body in there. I haven't heard of an oven collapsing on anyone, and I don't want to! Plus, it's just plain awkward managing tools and materials in there, so a helper really can help. Above: lead apprentice Perry Uber in Maya, the oven at Intaba's Wildfire restaurant.
Ocean Anderson, photo

Help! When I pulled out my sand form, some of the dome fell in.

If it was a minor collapse, and your oven is pretty thick, it might not make any difference and you can just leave it to dry.

If the mix is really wet and threatening complete collapse, stop and prop things up. Try wadding up rags or paper against the dome and holding them there with a stick just shorter than the height of your dome. Let things dry out.

You can also make a patch material of sticky plaster with extra clay and short straw or manure. Sometimes it can help to poke sticks or nails into the surrounding mud to give the plaster more to hold onto. (See safety note at left.)

Not only did it crack there are chunks falling out!

This may signal an inherent problem in your materials, or it may be due to oven abuse. If you steam your loaves, the shock of water hitting hot masonry can cause spalling. Long term, it can destroy an oven. The solution here is to quit using water, and enjoy the natural hearth crust created by the steam in the dough itself. If you must have steam, a high pressure misting nozzle for a hose might work; I've also heard of folks using small steam cleaning units. Hannah says that a pan of hot water in with the loaves won't do much.

If your oven is falling apart without steam, you may have too little, or poor quality clay in your mix, or it have have been too dry and not well compacted. There are things you can do. I have had success using a mineral binder called sodium silicate, or waterglass, available from ceramic suppliers and sometimes (at higher cost) from pharmacists. Mixed half and half with water, spray or brush it onto a cool, dry interior surface of a clean oven (no soot). It's caustic; avoid breathing spray or getting it on your skin. It will also etch glass, so keep it away from windows. Otherwise, it's an inert mineral that fuses with heat to bind and toughen your oven mix.

Another option is to re-line your oven with better (more clayey) stuff. Make a batch of sticky plaster with better building soil, and fine fiber to reduce shrinkage cracks. Paint the inside with clay slip to improve adhesion, and plaster the inside of the oven. Try multiple thin layers, building up to a half inch or so. Let it dry slowly (keep the door semi-closed).

The doorway is crumbling

Metal in the doorway can cause cracking due to differential expansion and contraction. Rough use is another cause. It's easy to rebuild a doorway, or to add a brick arch; see pages 46-49. See the note below on adding wet to dry material.

My all-clay oven is falling apart!

Assuming you didn't accidentally mistake clay for silt (not hard to do), it may be your mix was too dry, or not tamped hard enough, or both. Either would prevent the clay from cementing into a single, solid mass. You might be able to save it with waterglass or an internal plaster (see safety note at left). A new oven that seems to be dropping lots of sand may just need to have the last of the sand form swept off.

Is it OK to add wet material to dry?

Earthen plasters don't go through any chemical changes, so you have a lot of leeway — apply them when it suits you. Scratching the old surface helps adhesion, as does wetting it, and/or schmearing it with wet clay, or slip, before attaching fresh mix.

The lime plaster sounds beautiful — how tricky is it?

It's not that tricky to experiment with lime plasters, especially if you're primarily interested in color, but really good lime plaster is an art. It can be applied to dry mud, but wet the surface first; "lime water" is traditional, which is water that's had a bit of lime in it to make it basic. Slow drying maximizes strength. Ideally, plaster should be kept damp (and covered) for weeks or even months. It's an ancient and particular craft, so if you're interested, some research or training may be in order. Start with the Resources section.

DESIGN QUESTIONS

Which is better, the Quebec or beehive shape?

The Quebec clay-oven is deeper than wide, and higher at the rear, a bit like an egg on its side. Some say the shape is more efficient and draws better, and there may be truth there, but I suspect fuel quality and fire management are equally important for good performance. It seems to me, the best shape is the one that suits your needs.

Can I widen the door for pizza?

Door width is generally about half the diameter of a round oven, but where pizza making demands greater width, I'll compensate for widening the door by also widening or deepening the oven, effectively making it oval, like the Canadian oven. The more oval shape helps offset the cooling effect of a wider door.

Shouldn't pizza ovens be lower?

Interior dome height can be lower for a pizza oven, but for an oven 22.5" or smaller, less than 12" might start to constrict air flow and increase smoke problems.

What about making a really big oven?

If the oven gets too high you lose the concentrated steam that makes a good crust. But if the dome gets too low and flat, you risk collapse. For the four foot oven at Intaba's, I used a hanging rope or light chain to draw a strong "catenary" arch shape onto a piece of plywood. With the ends 4' apart, I adjusted the chain so it hung down 16" at the center (the top of the oven). I traced the line, cut out the plywood, flipped it up, and used it as a template to carve the right shape in my mound of packed sand.

What about a cement oven?

Regular Portland cement starts to break down at 700 degrees, and suffers from repeated thermal shock. The now classic plans from Sunset Magazine, for making an "adobe" oven "reinforced" with cement, are probably not improved by it. My experience is that adding cement to cob gives you the worst of both — weak, dusty, nasty to work with, cold, damp, and expensive. Calcium-aluminate cement (LaFarge, Fondue, Lumnite, etc.), on the other hand, is specially formulated for high-temperature use in kilns and boilers. It looks and works much like Portland cement, at two to three times the price. I've used it for a few ovens, with good results.

Can I use an oven to heat a house, or my water?

I wouldn't want my only source of indoor heat to be an oven. It would, of course, add some heat to a house, but there are bigger questions to be asked (see page 107). As for water, the answer would depend on how the oven was being used. Taking heat out of an oven that's in continuous use would

defeat your primary purpose, but you could try to capture waste heat from the chimney. If the oven is used occasionally, you could lay water pipes in such a way as to capture residual heat after the cooking is done. Such a system would require valves and drains to prevent steam and pressure buildup.

HAIDA SUN
Inspired by NW native (Haida) culture, and sculpted by Dennis Kuklok, in the rain-shadow of Washington's Olympic Peninsula. It gets tarped when the Pacific rains come in. Dennis is a permaculturist who works internationally, and is affiliated with Zopilote and the Cob Cottage Company. For info about natural building and permaculture workshops in the US and Mexico, contact Cob Cottage Co. at 541-396-1825, or cobcottage.com

How can I get a mud oven past code inspectors?

First, remember that the code is meant to protect you, and others. That said, plans for Intaba's oven specified it as a "cast clay-sand refractory" oven. It would have been fair to call it a masonry oven, a cast refractory oven, or just a wood-fired oven. In addition, American Flatbread in Vermont, as well as other small businesses, are using traditional earthen or "clay" ovens. For a discussion of EPA regulations for wood stoves, go to the handprintpress.com archives; there are other links as well, and lots more if you search the web.

Will aluminum foil improve heat retention?

The idea would be to put foil between the thermal mass and the insulation, shiny side towards the fire — to reflect heat back into the mass and reduce heat loss. But it strikes me as more trouble than it's worth. First, if the foil intereferes with the oven's ability to pass moisture, it could decrease efficiency and compromise the structure. Second, aluminum, like steel, oxidizes. Heat speeds up the reaction; so will salts or acids that might show up in an oven environment. So it's not clear how long the foil would last. Third, heat transfer is complex, and it's not clear how the foil would work in all the layers of an oven. Foil, like a mirror, reflects heat (which you can think of as infra-red light) back to the source. While foil between you and a fire can keep you cooler, the foil itself gets hot, so anything that touches it will get hot. A thermos works because the reflective layer is surrounded by a vacumn. An oven is more complex. I confess, I'm unlikely to pursue this, but I'd love to hear about your experience!

TWO SNAILS
by the author. The one on top was built as part of a Natural Building Colloquiium next to a straw-bale and cob greenhouse. When we discovered the the shell spiralled in the wrong direction, we designated it an "anti-snail" to protect the garden.
The bottom snail, less literal, was made in a two-day workshop and finish plastered afterwards.

AFTERWORD: EARTH, OVENS, ART

I grew up with my mother, an artist and single parent who always had interesting projects at home, taught me to make bread, let me skip school a day a week in sixth grade to learn ceramics from a professional, and encouraged me to go to Italy at 17 to carve marble. So bread and art have been constants, but I only started to make my living at them in my 30s, after abandoning institutional employment (for the last time, I hope) for better bread, more beauty, and less money. I didn't know exactly how I was going to go about it, but at one point, a friend who teaches anthropology invited me to hear a guest lecturer who "lived on $3,000 a year in a mud house he'd built for $500." It sounded useful.

The lecturer was a Welshman named Ianto Evans. He has lived and worked all over the world; his slide lectures illustrate what is sometimes called "permaculture," or "appropriate technology." What I saw, however, was a brilliant and very specific illustration of the practical relationship between beauty and function — in everything from gardens to houses to stacks of brooms packed and loaded onto overloaded buses in Guatemala.

Ianto spent the night at a neighbor's house, so I got to visit and hear more about the "Cob Cottage Company," which he had just set up, with his wife Linda Smiley, and their partner Michael Smith. They offered hands-on courses on earthen building. I spent a week with them and about 15 other students, working on a small house. One afternoon, we built a mud oven similar to ovens made all over the world by all kinds of people. The next day we had fresh bread.

The next few months I spent traveling. When I arrived in Minnesota to visit my father and his wife of 30 years, the highlight of every meal was Mary's bread, an absolutely wonderful, traditional European sourdough the likes of which I hadn't tasted since the summer I spent in France when I was 12. Mary's bread book recommended a "backyard brick oven." I suggested mud instead, and spent several hot, sticky Minnesota summer days digging a deep hole and converting an old section of limestone wall into a deep foundation (protection against the long, hard Minnesota winters — the frost line was three feet down). I dug and hauled sand and dirt by pickup truck and wheelbarrow, and finished the oven in another day or two. A few weeks later, when I got to my

MARY'S OVEN
I started with a plain dome, and added a chimney later, just to see how it would work.

"GOONA ZOONA"
New York's Long Island is a glacial "moraine," a pile of sand and gravel left by retreating glaciers after the last ice age. The building soil wasn't great, but it worked out OK.

brother's house, I showed him pictures. He wanted one. Neighborhood kids helped, and it came out in the shape of a mythical creature. The three-year old named it "Goona Zoona."

Both ovens had some serious mistakes. My father wanted a cement stucco on his — it failed and the oven is no longer. For the second one, a relative suggested slanting the floor up towards the rear, to improve combustion. That would have worked fine with a chimney in back — but with a chimney in front, the fire couldn't burn all the way back — so my brother had to add a rear chimney. I tried a gypsum plaster on this one (no time to build a roof, and I didn't know about lime plasters). I think it soaked up more water than it shed. But for my brother's wedding the next summer, it baked seventeen loaves of sourdough in three batches: 20 minutes for the first, 45 for the second, and an hour for the third — all on a single firing. When the old maple tree dropped a limb that winter, Goona Zoona took the blow. The next one will be better.

As for bread, I grew up watching my mother bake. She is an artist who rarely uses recipes. In a book she wrote on bread sculpture she said, "there are no mistakes, just new ways to make bread." When I was twelve, she sent me to a farm in Brittany (an experience worth more than most camps). I learned French, worked in the fields, played (and fought) with the owner's grandkids. We ate lots of "pain de campagne." Once or twice a week, "Granmere" bought several two- or three-foot loaves at the local bakery, and stored them in a big wooden box in the kitchen. Afternoon snack, or "goutée," was a thick slab, buttered and sprinkled with sugar. Breakfast was the same buttered slabs dipped in a bowl of hot milk, chocolate, or coffee. It was thick, chewy, and a little tart, with a strong brown crust that felt good between your teeth. Every time I dip toast in coffee, I remember that breakfast, and particularly that bread. But for too long it was a wistful memory, since such bread seemingly wasn't to be found or made on this side of the Atlantic.

Luckily, when I was learning to make ovens, my "other mother" was learning to make authentic French "pain au levain" (bread from starter). She also is an artist, but precise and methodical, which is what production pottery requires in order to make a living at it. Not surprisingly, she makes good use of cookbooks, where she learned to make traditional sourdoughs.

BREAD & FREEDOM

At a panel discussion on the World Trade Organization, I heard of European citizens who refused to buy US beef raised with hormones. The WTO allowed the US to impose trade sanctions until the ban on US beef was lifted. What's "free" about that? I don't want to eat hormone-treated beef either. But the WTO gives such power to corporations. They can impose their will on people with little or no accountability to anyone. America revolted against the English crown for less. Unelected kings are little different than unelected companies. And corporations aren't even people. By law, they have acquired the right of "free speech," but by commerce they have gained so much control over international media that their "message" has become gospel. So I sat there thinking about what to say or do.... What came to my mind was: Grow a garden, buy (or grow my own) organic wheat, and make my own bread.... Such is not protest, it is principle.

Better than the book, however, was watching Mary knead her dough and tend her jars of wild yeast starters. While I had made decent bread for years, it wasn't until I saw Mary at work that I began to understand good bread. And as my own bread improved, I was also making ovens, and noticing how it was consistently better out of a mud oven. It took a little while for my brain to catch up with what my body was doing, but I finally started to see the obvious: "aha!"

While I have made some pretty nice loaves in a modern range, modern baking (and much of modern life) knows very little about that practical, beautiful, and essential phenomenon that transforms earth, water, air, and fire into life. Bread begins with fertile soil, sun, and seed; they have given us grain and flour and loaf and life. It is an impressive debt we accept in return for our bread; one we can repay, in the end, only with our lives and our bodies. Dust we are, and to dust we return. But it's holy dust, and like the phoenix, it must be reborn.

Like all art, oven-building and bread-baking heighten your awareness of essential cycles — things that are, in the end, beyond knowing. Whether or not you understand all the hows and whys doesn't really matter. If you make bread, you can make bread! What is important and valuable is that you do it.

The real value of good bread, I think, may be this: when you are aware of your relationships with the world, you realize they can't be measured in dollars. Only life has value; how can you measure it? It is not earning and spending, but giving and receiving, freely.

Romanian sculptor Constantin Brancusi said that "sculpture must be lovely to touch, friendly to live with, not only well-made." If that doesn't describe bread, I will stop eating. Bread, like art, is an invitation — to sit, to rest, to tell stories; to cook, to share, to make parties, feasts, and festivals. An earthen oven is also such an invitation, and its full, round form is indeed, "lovely to touch, friendly to live with...." And while bread and ovens are rarely immortalized in museums and history books, they are art — they are the shaping of materials to create new forms and thus, new life.

Art is not born in galleries — it is our common heritage, and if you can become completely absorbed, even for a moment, in the creation of something new — be it as simple as a mud oven or a loaf of bread — you know something that no one can teach and that no money can buy.

What's the alternative? If we are what we eat, then what do

we become when we eat bread from factories where human hands never touch the dough? What relationships are we nurturing? Is corporate-sponsored consumerism our ultimate and final purpose?

Life asks us to participate — to watch, to learn, and to create. To be either artist or craftsman is no more and no less than it is to be human: to engage hands, head, and heart in the genesis of form and relationship; to celebrate and renew self and world; to be whole and wholly involved; to offer communion and to build community; or just to make a mud oven so you can bake your own bread.

KOOTENEY OVEN
Hannah helped build this oven in British Columbia, using pure clay and the classic Canadian alder frame. Note the simple, easy ash dump. *Uli Holtkamp & Sean Hennesey, photos & oven*

CONTACT INFO:
People and organizations mentioned in this book are listed below, either as teachers, builder/masons, or other. This is by no means meant to be a comprehensive list of all the available resources (which are many!), but it might help you begin. Start close to home, whether you're looking for an oven-builder or a course on how to build a cob cottage! Websites seem to change so much that I've only listed a few sure ones.

NATURAL BUILDING TEACHERS

- strawhomes.com is the site of *The Last Straw* Journal, HC 66 Box 119, Hillsboro NM 88042, 505-895-5400.
- Cobcottage.com, Cob Cottage Co. & No. Am. School of Natural Building, 541-396-1825.
- housealive.org, 541-899-3751; cob & natural building, Coenraad Rogmans (OR)
- Pat Henneberry, Vancouver Isl., BC, Cobworks.com

BUILDER/MASONS

- Alan Scott & Ovencrafters: info@ovencrafters.net
- Christina Davis and Aaron Blake, Reworks, Inc, Corbett, OR, reworks@cascadeaccess.com
- Hendrik Lepel, oven-builder, ireland, kirdnehl@hotmail.com
- Masonry Heater Association, mha-net.org

RESOURCES

BREAD, OVENS, FIRE

The Book of Bread, by Jerome Assire, Flammarion, 1996; an overview of the history and culture(s) of bread, from seed to loaf, with beautiful photographs.

The Bread Book: A Natural, Whole-Grain Seed-to-Loaf Approach to Real Bread, by Thom Leonard, East-West books, 1990; how to make Flemish Desem bread and grow and mill your own grain; plus plans and instructions for building an Alan Scott style brick oven. Out of print, but available used.

The Bread Builders: Hearth Loaves and Masonry Ovens, Dan Wing and Alan Scott, 1999, Chelsea Green. In-depth info on bread and ovens; brick oven plans, and sources for everything from modular ovens, to flour and oven tools. Alan Scott also provides consulting, workshops, custom plans, and various related goods through Ovencrafters; 5600 Marshall-Petaluma Rd, Petaluma, CA 94952, phone/fax: 415-663-9010; info@ovencrafters.net.

The Bread Ovens of Quebec, by Lise Boily, Jean Francois Blanchette, 1979, Canadian Center for Folk Culture Studies, Ottawa Canada K1A 0M8. Documentary history of traditional Canadian clay ovens, and those who made and used them. Includes oven construction.

Building a Wood-Fired Oven for Bread and Pizza, by Tom Jaine, 1996, Prospect Books, Totnes, Devon, UK. History of ovens, how to build and use a brick oven.

Construire un four á pain, & Les vieux fours á pain, by Pierre Delacrétaz, 1993, Cabédita (Switz.), classic French texts on traditional masonry ovens and their use.

"Constructing an Earth Kiln," by E. Starnater, *Wilderness Way.*, V. 9, no. 4, $4, POB 621, Bellaire, TX 77402

The Book of Masonry Stoves, by David Lyle, Chelsea Green, 1984. Promotes & explains what may be the most efficient means of heating with wood. Covers wood-burning history, oven mechanics, and technical details of stove building. On the same topic, see also *Finnish Fireplaces: The Heart of the Home,* by Albert Barden & Heikki Hyytiainen, 1993, Helsinki, The Finnish Building Center, and the Masonry Heater Association (mha-net.org).

English Bread and Yeast Cookery, by Elizabeth David. Classic; covers everything from the history of grain and ovens, to a final chapter on "toast."

The Laurel's Kitchen Bread Book, A Guide to Whole Grain Bread Making, by Laurel Robertson, with Carol Flinders and Bronwen Godfrey, Random House, 1984; Flemish Desem recipe, and more.

The Magic of Fire: Hearth Cooking: One Hundred Recipes for the Fireplace or Campfire, by William Rubel. 2002, Ten Speed Press. Celebrates the "rustic spirit of improvisation;" documents methods, tools, and techniques for cooking on open fire which can also be applied to wood fired ovens. williamrubel.com provides info on suppliers, methods, related food traditions (bread, gardens, mushrooms, alcohol, etc.), and chat groups.

EARTH & BUILDING

American Boys Handibook, by D.C. Beard (one of the founders of the Boy Scouts), David Godine. Published in the1890s as a scouting manual, it still offers modern kids a variety of good things to do and make.

Butabu: Adobe Architecture of West Africa, by James Morris and Suzanne Preston Blier, Princeton U. Press, Sahalian Architecture in Mali, Niger, Nigeria, Togo, Benin, Ghana, and Burkina Faso, where people have been constructing earthen buildings for centuries.

The Cob Builder's Handbook, by Becky Bee, from Groundworks, POB 381, Murphy OR 97533.

Dirt, The Ecstatic Skin of the Earth, by William Bryant Logan, Riverhead Press, 1995. Inspiration and information.

The Hand Sculpted House, by Evans, Smith, and Smiley; *The Cobber's Companion,* by Michael Smith, *Earth Building and the Cob Revival,* a Reader, from: The Cob Cottage Co., Box 942, Coquille, OR, 97423, 541-396-1825.

The Homestead Builder: Practical Hints for Handy-men, by C. P. Dwyer. practical homestead advice using basic materials available on most sites.

The Humanure Handbook: A Guide to Composting Human Manure, by Joseph Jenkins, Jenkins Publishing. If we composted our manure instead of flushing it, we'd solve many problems and safely complete the bread cycle.

In the Deserts of this Earth, by Uwe George, Harcourt, Brace, Jovanovich, 1979; fascinating study of where life may ultimately be headed.

Lime in Building, by Jane Schofield, Black Dog Press; "A Practical Guide" to the use of lime in plastering, including slaking your own lime putty; from Taylor Publishing, which carries a full catalog of natural building books; POB 6985, Eureka CA 95502; 1-888-441-1632; www.northcoast.com/~tms.

Little House on a Small Planet, by Shay Salomon, Gibbs Smith, 2006. The author argues, rightly, that the best thing you can do to be "green" and "efficient" in your home is to keep it small. Essays, interviews with small house-dwellers, floorplans, inspiration. littlehouseonasmallplanet.com.

The Art of Natural Building, Joseph F. Kennedy, Michael G. Smith and Catherine Wanek, editors; New Society Publishers, 2002, Canada.

Building with Earth, A Handbook, by John Norton, ITDG, 1997, London.

The Natural Plaster Book: Earth, Lime and Gypsum Plasters for Natural Homes, by Cedar Rose Guelberth & Dan Chiras, New Society Publishers, 2003, Canada. Building for Health Materials Center, POB 113, Carbondale CO 81623, 800-292-4838, buildingforhealth.com

A Pattern Language, by Christopher Alexander et al, Oxford U. Press, 1977; a practical manual for finding and applying good "patterns" for living and building; broken down into small, practical chunks that can be applied to home, neighborhood, city, or nation.

Secrets of the Soil, Tompkins & Bird, Harper & Row, Perennial, 1990; provocative inquiry into unanswered questions about how dirt works.

Spectacular Vernacular: The Adobe Traditions of West Africa, Jean Louis Bourgeois & Carollee Pelos, Aperture, 1996; text & photo survey of an inspirational tradition of earthen building.

• Tara Johnston, design/builder, Gather Studio, PO Box 948, Hood River, OR 97031, 541-386-5562, tara@gatherdesign.com

OTHERS OF INTEREST

• Aprovecho.org, for efficient woodstoves and appropriate technology
• barmbaker.com, the website of Alton Spiller, Inc., for scalded doughs and related uses of "barm techniques."
• City Repair Portland (OR), cityrepair.org
• fornobravo.com has free brick oven plans
• Hiram Trust, Tel/Fax 01453 764065; www.anth.org.uk/hiramtrust.
• Oregon's Solwest Renewable Energy Fair, solwest.org
• solarcooking.org
• Wes Jackson's Land Institute, thelandinstitute.org
• yahoogroups brick-oven group: groups.yahoo.com

FOOD & CULTURE

Farmers of Forty Centuries, & other essential titles, downloadable FREE from www.soilandhealth.org, Steve Solomon's public web-library.

On Food and Cooking: The Science and Lore of the Kitchen, by Harold McGee, 1984; NY, Simon & Schuster; answers all the whys and hows of bread, water, yeast, eggs, milk, and (almost) everything else in the kitchen.

Hungry Planet: What The World Eats, by Peter Menzel and Faith D'Aluisio, Ten Speed Press, 2005. Photos of families around the world with all their food for a week. It is one thing to know about material inequality and the destruction of culture; it is another thing to see it inventoried.

Keeping Food Fresh: Old World Techniques and Recipes, by The Gardeners & Farmers of Terre Vivant, Chelsea Green, 1999. Preservation can maintain or enhance life in food, rather than killing it with sterilizing heat or chemicals. Traditional live foods now considered "gourmet" were standard items that nourished long-lived people of many cultures.

Living Water, Viktor Schauberger and the Secrets of Natural Energy, Olof Alexandersson, Gateway/Gill & Macmillan, Dublin; Schauberger's scientific & practical achievements with water remain to be explained; fascinating.

The Lost Language of Plants, by Stephen H. Buhner, Chelsea Green, 2002; arguments & evidence for listening more closely to green growing things.

"The oil we eat: following the food chain back to Iraq," by Richard Manning, *Harper's* magazine, Feb, 2004. Also: *Against the Grain: How Agriculture Has Hijacked Civilization,* North Point Press, 2004.

The Unsettling of America (essays on culture and agriculture); *Jayber Crow* (a novel), by Wendell Berry, whose moral logic is necessary armor against the arrogance of unexamined and undemocratic ("scientific") thinking.

Water Wars, Vandana Shiva, South End Press, 2002. also *Stolen Harvest: the Hijacking of the Global Food Supply,* on genetic engineering and global agriculture. Shiva was a leading physicist before deciding to address the impacts of globalization, not only on India, but the world.

Wild Fermentation: The Flavor, Nutrition, and Craft of Live-Culture Foods, by Sandor Ellix Katz, Chelsea Green, 2003. Make sauerkraut, kimchi, pickles; miso, tempeh, dosas, and idli; yogurt, kefir, cheese, bread, wine, beer, and vinegar; nearly 100 recipes.

An Underground History of America Education, by John Taylor Gatto, 2006, Oxford Village Press, NY, johntaylorgatto.com. He says "public education" is neither. The history he covers suggests that industrial education is much like industrial food — both empty and artificial.

Zuñi Breadstuff, Frank Hamilton Cushing, 1920, New York Museum of the American Indian, Heye Foundation. Describes the braided strands of land, people, history, bread and culture among the Zuñis. The author was adopted, initiated into religious mysteries, and became second chief of the tribe. John Wesley Powell called him a genius of manual arts, intellect, and insight. Out of print, but available through libraries.

INDEX

A
activate starter, 78
agricultural lime *see* lime
air flow, and fire, 68, 96-97
air pressure, and temperature, 97
all-clay oven, 103
allergy, gluten, 83
alternative
    cooking, 103-106
    home heating, 107
amending building soil, 26, 52
The American Boy's Handy Book, 14
Aprovecho Institute, 105, 106, 107
arch
    brick, 45
    making, 48-49
    and sand form, 51
art, 117, 120
artisan bread, 75
ash dump design, 39

B
baking
    bread, 75-87
    in conventional oven, 82
    loading loaves, 70
    and masonry, 93
    oven spring, 9, 82
    pizza, 71-72
    routine, 76-77
    several meals, 82
    soaking oven door, 69
    temperature, 69, 82
    temperature test, 70
    timing, 77, 81
    tools, 16, 36, 72-73
    why in an earthen oven, 7
    see also bread
bark, dust and mulch. 33
bartering and bread, 75
basket
    dome, 51, 103
    proofing bread in, 81
beach sand, 32
beginner, advice to, 4-5, 13-14
blowpipe, 73, 91
Boily and Blanchette, 57
bottle insulation, 42
Bourgeois , Jean-Louis, 10
box, fire, 102
Brancusi, Constantin, 120
bread
    artisan, 75
    in Brittany, 119
    cycle, 6
    Haiku, 87
    loading into oven, 70
    making, 75-87
    Mary's, 117, 119-120
    mother's, 119
    pita, 82
    proofing in baskets, 81
    sourdough, 75-87
    storing, 78
    timeline, 77-78
    see also baking; dough; flour; sourdough
Bread and Puppet theatre, 99
The Bread Builders, 101, 105
The Bread Ovens of Quebec, 57
breathable plaster, 64
brick
    door arch, 36, 45, 48-49
    oven, 1-2, 99, 105
    oven floor, 35, 43-45
    test, 27-28
bucket blender, 41, 53
Building Code, 31
building soil, 25, 31-33
    amending, 26, 52
    redi-mix, 52
    tests, 25-28
    see also earth; soil
building the oven, steps in, 38-57
burning, principles, 88-91

C
Canadian-style oven, 33, 103
capillary break, 39, 41
Capturing Heat, 106
Carlson, Bob, 87
Carolee Pelos, 10
chimney, 94-95, 96, 97
City Repair Project, 102
Clavel, Bernard, 75
clay
    all-, oven, 103
    building block of life, 24
    properties of, 24-25
    redi-mix, 52
    sculpting, 59-65
    slip, 16-17, 41
    tests, 25-28
    types of, 32
    see also earth; mud; soil
clean oven floor, 70
cloche oven, 99
clome oven, 99
The Coal Question, 90
cob
    explained, 10-11
    recipe, 60
    see also mud; oven mud
Cob Cottage Company, 117
color, earth, 64
combustion, secondary, 102
combustion, 68
community oven, 101-102
concrete sand, 32
conditioning bread dough, 79
conduction
    energy transfer, 8-9
    heat, 92-93
Constructing an Earth Kiln, 104
Construire un four a pain, 98
containment rings, 40
convection energy transfer, 8-9
conventional oven, baking, 82
cooking
    in oven, 71
    temperatures, 69
Cooking with Fire in Public Spaces, 101
cracking, p. 69, 111
Cushing, Frank Hamilton, 6

D
D C Beard, 14
dagga, 62
damper, 97
deadman, 60
deforestation, and fuel efficiency, 3
Delacretaz, Pierre, 98
design
    ancient, 98-99
    aspects, 18, 22-23, 38
diagram, oven, 38
dimensions

chimney, 94-95
foundation, 40
hearth floor, 18
oven, 16, 22
oven door, 45-49, 57
oven mud layers, 54-55
sand dome, 50-51
see also proportions
dirt *see* earth
Dirt, the Ecstatic Skin of the Earth, 24
dome, shaping, 50-51
door
arch, 36, 45, 48-49
extended, 46
dual-duty cob, 47
firing, 68-69, 94, 97
flanged, 46
oven, 36, 45-49, 57
soaking, 69
doorway, cutting open, 57
dough
amount of starter in, 87
fermentation, 80-81
kneading and conditioning, 79
salt in, 84
scalding flour, 85
water in, 84
see also bread; sourdough
downdraft, 94
draft, 96-97
drain trench, 41
drying
oven, 56
wood, 67
dual-duty cob doors, 47
Duguid and Alford, 13
Dutch oven, 99

E
earth
as building material, 24
colored, 64
see also mud; oven mud; soil
earthen
building, 10-11
ovens for the world, 105
see also earth; oven mud
efficiency
bad, 90
in burning, 90-91
and deforestation, 3
fuel, 68
impractical definition, 91
masonry oven, 93
test for oven, 93
Eisenberg, David, 31
Evans, Ianto, 10-11, 107, 117
experiment one, hole in the ground, 14-15
experiment two, larger higher hole, 15-16
extended door, 46

F
FAQ, 109-115
fermentation, dough, 80-81
fibers, 62
finish
layer *see* plaster
mud *see* plaster
fire
air flow, 68
blowpipe, 72, 73, 91
box, 102
and bread cycle, 88-90
cooking around the world with, 12-14
cooking with live, 71
draft and, 96-97
drying oven with, 15, 56
efficient, 90-91
metaphysics, 88-90
and photosynthesis, 89-90
removing remains, 69
turbulence and, 90-91, 97
wood for, 67-68
see also burning; efficiency; temperature
firebricks, 35
fireclay, 32
firing door, 47, 68-69, 94, 97
first layer oven mud, 52-55
flanged door, 46
Flatbreads and Flavors, 13
floor
cleaning oven, 70
hearth, 18, 34-35, 43-45
heat sink, 42-43
insulation, 41-43
subfloor rings, 42
flour
and gluten, 79, 83, 84
grinding, 80
scalding, 85
types of, 83
wheat vs. white, 83
see also bread; dough; sourdough
footing, 49
form, sand *see* sand form
foundation
building, 39-41
capillary break, 39, 41
containment rings, 40
draining, 41
footing, 40
frost line, 40
options, 18, 39
rock, 31
subfloor, 40
urbanite, 31
see also materials
frost line, 40
fuel
efficiency, 90-91
in masonry ovens, 93
wood as, 67-68
see also burning; efficiency; fire

G
Gibran, Kahlil, 50
glass bottles, as insulation, 34
gloves, oven, 72
gluten, 79
graded sand, 32
grinding flour, 80

H
Haiku, sourdough bread, 87
The Hand-Sculpted Home, 10
Hannah's story, 76-77, see caption, 87
hay box, cooking in, 105-106
hearth floor *see* floor
heat
conduction, 8-9, 92
convection, 8-9
and masonry, 91, 93
radiant, 8-9
resistance, 92
soaking oven with, 70
and surface area, 96
transfer, 91-93, 96
two-chamber oven, 102
see also burning; efficiency; fire;

temperature
heat sink, 42-43
heating, home, 107
hinged roof, 30
home heating, 107

I
illustrations *see* oven photos
insulation
bottle, 42
floor, 41-43
heat transfer, 93
making, 33-34
oven, 16, 18, 57
sawdust, 33, 42
see also oven mud; plaster

J
Jackson, Lesley, 107
Jackson, Wes, 90
Jeavons Paradox, 90

K
Kiko's story, 117-121
kilns, earthen oven used for, 104
kneading, 79

L
layer
finish, 61-63
first, 52-55
second, 57
see also insulation; oven mud; plaster
life expectancy, 109
lime plaster, 64
live fire cooking, 71
loading loaves, 70, 82
location of oven, 20-21

M
making oven mud, 53-54
masonry, 24
and heat, 91, 93
making most of, 93
see also brick; oven
mason's lime *see* lime plaster
mason's sand *see* sand
materials
arch, 36, 45-49
building soil, 24-25, 31-32, 52
door, 36, 45-49
foundation, 39
hearth floor, 35
insulation, 33-34, 41-42, 57
locating, 29, 34
making do, 29
parting layer, 36
plaster, 61-63
prep list, 31-37
quantities of, 29-30
sand, 33
sand form, 50-51
structural cob, 59-61
tools, 36-37
wood, 67
McGee, Harold, 83
measurements, *see* proportions, *see also* dimensions
medieval mobile oven, 98
metaphysics of fire, 88-90
mineral insulation, 42
mini ovens, 15
mixing
oven mud, 52-54
plaster, 62-63
tarp technique, 28
workspace for, 37
mobile ovens, 98-101
moldy sourdough starter, 87
mud
arch, 46
arguments for, 1-2
and different cultures, 10
sculpting, 24, 59-65
sculpting recipe, 60
see also cob; earth; oven mud

N
newspaper parting layer, 36

O
On Food and Cooking, 83
organizing workspace, 37
oven
all clay, 103
beauty of, 24
beginner's experiments, 14-17
brick, 1-2, 99, 105
building, 38-57
cleaning floor of, 70
community, 101-102
cracking, p. 69, 111
diagram, 38
door, 36, 45-49, 57, 68-69
drying, 15, 56
early experiments, 117-119
fire, 68-69
floor, 35, 43-45
foundation, 18, 39
heat sink, 42-43
heat soak, 70
introduction to earthen, 79
life expectancy, 109
location, 20-21
mobile, 98-101
other uses, 104
in public spaces, 102
roof, 23
sand form, 50-51, 55, 56
sculpture, 55, 59-65
size of, 22
solar, 105-106
tools, 17, 36-37, 63, 72-73
two-chamber, 102
Winiarski rocket, 93, 96, 105, 106
workspace organization, 37
see also baking; heating; materials; temperature
oven mud
finish, 61-63
layers, 54-55
making, 53-54
materials, 29-30
mixing, 28, 52-54
prep list, 31-37
recipe, 52
sculpture, 59-65
structural, 59-61
thermal mix, 33
see also clay; cob; insulation; mud; plaster; proportions
oven photos
Anne's Lizard in Wales, 9
Ardilla Oven in Mexico, 31
around the world, 12-14
Bali-inspired Greenhouse oven, 97
Basket Oven, 103
Buena Vista commercial oven in Oregon, 108
Falcon, Oregon, 65, 77

Frobearilla, Oregon, 65
Frog, 67
Goona Zoona, 118
Guajolote (Turkey), Mexico, 58
Haida-inspired, Washington, 108
Hendrik's oven, Italy, 2
Hungarian Oven, 86
Kiko & Hannah's Home Oven, 19
Kooteney Oven, 87
Lennie Kakalecik's oven, Colorado, 7
Mary's oven, 118
Maya, Oregon, 112
Medieval mobile oven drawing, 98
Mexican Turtle, 91
Minnesota oven, 121
mobile ovens, 100
Mud Man Oven, Oregon, 11
one-day oven, Minnesota, 16
Oven, Bench, Shelter, Vancouver, BC, Canada, 95
Pig in a Garden, Oregon, 101
Plimoth Oven, 85
Two Snails, 116
Urban Mud, New York, 102
Urban Mud, Seattle, 33
oven spring, 9, 82

P
peel, 36, 69, 70, 72
perlite, 34
photos, *see* oven photos
photosynthesis, and fire, 89-90
pita bread, 82
pizza
baking, 71-72
brush, 72
plaster
finish layer, 61-63
finish mud, 16, 61-62
lime, 64
waterproofing, 23
see also earth; insulation; oven mud; sculpture
potter's clay, 32
pottery kilns, earthen oven used for, 104
prep list, oven mud mix, 31-37
pressure, air, 97
proofing loaves, 81
The Prophet, 74
proportions
amending soil, 26, 52
hearth floor bricks, 35
oven mud, 29-30, 33, 52
soil, 25-28
water, 51
see also dimensions; oven mud
public spaces, ovens in, 102
pumice, 34

Q
quantities of materials, 29-30
quarter minus sand, 32
Quebec oven, 103

R
radiant energy transfer, 8-9
rake (rooker), 36, 69, 72
recipe
cob, 60
mud, 52
plaster, 62
sourdough bread, 78
sourdough starter, 86-87
red bricks, 35
redi-mix soil, 52
removing fire remains, 69
Renewable Energy Policy Project (REPP), 106
resistance, heat, 92
rings, subfloor, 42
Rocket Mass Heaters, 107
rocket oven, 106
roof
hinged, 30
oven, 23
rooker (rake), 36, 69, 72
routine, baking, 76-77

S
salt, 84
saltillo tile, 35
sand
characteristics of, 32-33
chart, 24
form, 50-51
types of, 32-33
sand form
layer of oven mud on, 55
making, 50-51
removing, 56
sawdust
insulation, 33, 42
warning, 57
scalding flour, 85
Schumann, Peter, 99
Scott, Alan, 94, 101, 105
scuffle, 36, 72
sculpture
chimneys, 94-95
cob, 59-65
cob recipe, 60
life and, 120
oven, 55
straw, 34
tools, 61, 63
tricks, 60-61
see also art; oven mud; plaster
secondary combustion, 102
setting floor bricks, 44-45
shake test, 25-26
silt, 25
slip, clay, 16-17, 41
Smiley, Linda, 10-11
Smith, Michael, 10-11
smoke *see* chimney; fire
snake test, 26-27
soak oven with heat, 70
sodium silicate, 112
soil
building, 25, 31-32
amending soil, 26, 52
redi-mix, 52
tests, 25-28
see also earth; mud; oven mud; plaster
solar, oven, 105-106
sourdough
bread making, 75-87
bread recipe, 78
fermentation, 80-81
Haiku, 87
moldy starter, 87
starter recipe, 86-87
see also baking; bread; dough; flour
Spectacular Vernacular, 10
splooges, 60
squeeze test, 28
starter *see* sourdough, starter
steps, oven-making, 38-57

storage, bread, 78
straw, 34, 59-60
straw wattle, 60-61
structural cob, 59-61
sub-floor insulation, 18, 34
subfloor, 40
subsoil, 25
surface area, heat transfer, 96

T
tandoors, earthen oven used for, 104
tarp technique, 28
temperature
    adjusting, 71
    and air pressure, 97
    baking, 82
    and burning, 90-91
    estimating, 69
    testing, 70
    and time, 90-91
    see also burning; fire; heat
test
    baking temp, 70
    bread done, 83
    finish mud, 62
    insulation, 33
    efficiency, 93
    soil, 25-28
thermal mass
    & heat transfer, 92
    & home heat, 107
thermal mix, 33
tile, saltillo, 35
time, and temperature, 90-91
timing
    baking bread, 77, 81
    cooking in oven, 71
tools
    baking, 16, 36
    bucket blender, 41, 53
    oven, 72-73
    oven building, 17, 37
    pizza brush, 72
    sculpting, 61, 63
    see also materials
topsoil, 25
trailers, for mobile ovens, 100-101
transfer, heat, 8-9, 91-93
tricks, sculpting, 60-61
troubleshooting, 109-115

Mixing mud for an oven at Casa Del Sol in New York City's South Bronx, a project initiated by a college intern working with 50 community volunteers. *Photo courtesy of project coordinator Beth Ferguson.*

turbulence, and fire, 90-91, 97
two-chamber oven, 102

U
urbanite, 31

V
Venturi Effect, 97
vermiculite, 34
void, shaping the, 50-51

W
waste clay, 32
water
    in bread, 84
    in cob mix, 60
    for oven mud, 31
    in sand dome, 51
waterglass, 112
water resistant plaster, 64
waterproofing, 23
wheat paste, 63
white flour vs. wheat, 83
whitewash, 64
Wing, Dan, 101, 105
Winiarski, Larry, 106
Winiarski rocket oven, 93, 96, 105, 106
wood
    drying in oven, 67
    as oven fuel, 67-68
workspace
    organization, 37
    and roofs, 23

Z
Zuni Breadstuff, 6, 12

Photo courtesy of Brooks Stanfield

THANK YOU

Many have taken parts in this conversation. Writing out even a partial list, however, makes me appreciate how help is, really, as common (and as rich) as dirt. For all those diverse and often miraculous gifts, from large to small, I am indebted and grateful beyond telling. For particular generosity, inspiration, and example, especially related to ovens, mud, art, and books, thanks to: All the builder/readers who either read drafts of the text or sent photos and stories (their names are scattered throughout); numerous workshop participants (especially hosts); and all the Cob Companions who have left their muddy tracks all over (for many years, now!), plus: Alan Scott; Alejandra Caballero & Paco Gomez; Andrew Whitley; Ann Wiseman; Bev Brown, Bill & Athena Steen, Bob Carlson, Brickovengroup members who share experience and enthusiasm daily, Catherine Wanek, Charlie Bremer, Clark Sanders, Coenraad Rogmans, Connie Battaile, Dan Wing, Dawn Leslie, Ianto Evans, Jason Saunders, Larry Winiarski & Aprovecho, Linda Smiley, Michael Smith, Peter & Mary Denzer, Pete Fust, Piet Vermeer; Sandy Arbogast, Shelley Wiseman, Suz Doyle (& Corvallis Unity), and Tee Corinne. A continuing thank you to all the Grants, who made room for me to make a home and a garden where I could plant seeds (given by others), watch them grow, and learn. And thanks to Hannah, for courage and companionship to search /fields, forests, and cities/for daily bread and joy.

Photos courtesy of Debbie Murphy

PRAISE FOR THE 2ND EDITION:

Creative. Innovative. Brilliant. This is the definitive book on how to build an adobe oven...
— William Rubel, author, *The Magic of Fire*

Build Your Own Earth Oven is the essential book for those who want to do just that. It is worth many times its price in avoided labor and frustration, and the ample and enjoyable illustrations are a great guide to those (mud builders and dough makers) who use the right brain more than the left. Go on — Get Dirty!
– Dan Wing, co-author, *The Bread Builders, Hearth Loaves & Masonry Ovens*

…[It] will awaken in you and connect you to the artisan vision, where earth meets hand meets spirit.
– Peter Reinhart, author, *The Bread Baker's Apprentice*, and *Crust and Crumb*

...simplicity itself: brief, brisk, artful, and well-written....explains the principles of breadmaking with a few deft strokes...Graceful, well-detailed, and empowering throughout, this book can justly claim to have pioneered new cultural territory: fruit of a new movement for sustainability, it celebrates the pleasure of living well with the earth. **— Peter Bane, *Permaculture Activist.***

...the most enjoyable, down-to-earth and sensible account of building what you all need in your back gardens...His instructions for the building are clear as rainwater, his advice...intelligent and sound...
— Tom Jaine, *Petit Propos Culinaire*, UK.

Kiko Denzer's gift is to bring together in one small book both the means to make an inexpensive oven which will surely bake wonderful bread, and a gently impassioned explanation of why to do this matters.
– Andrew Whitley, Founder, The Village Bakery, U.K.

The illustrations really make it accessible, and the information is such a good blend of science and love.
— Mark Peter Keane, author, *Japanese Garden Design*

I've always wanted a brick oven but knew I'd never be able to afford one. When I discovered your book I was thrilled.... what you teach is simple, humble, affordable and attainable!
— Kevin (via email)

Kiko Denzer began sculpting earth in 1994, after giving up professional life to grow food & make other art. His latest book is *Dig Your Hands in the Dirt: A Manual for Making Art out of Earth*. He also teaches. **Hannah Field** baked at the Cumbrian (wood-fired) Village Bakery, and at The Celtic Baker in London; she now raises non-certified organic boys & vegetables, and is a massage therapist. They live in Oregon, where they share a home, garden, & two sons.

ISBN 978-0-9679846-7-4
9 780967 984674 51795
$17.95

Food & Cooking / Home & Garden

Hand Print Press • POB 576 • Blodgett OR 97326 • handprintpress.com
Distributed by Chelsea Green • 800-639-4099 • chelseagreen.com